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STATE OF MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY

MAY, 1976

FINAL REPORT

HENNINGSON, DURHAM & RICHARDSON
ENGINEERING • ARCHITECTURE • PLANNING • SYSTEMS • ECONOMICS
HELENA, MONTANA
ATLANTA · CHARLOTTE · CHICAGO · DALLAS · DENVER · LOS ANGELES · MINNEAPOLIS · NEW ORLEANS · NORFOLK, VA
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ENERGY AND SECONDARY MATERIALS MARKET REPORT

FOR

STATE OF MONTANA

SOLID WASTE MANAGEMENT
AND
RESOURCE RECOVERY STUDY

MAY 1976

FINAL REPORT

MAR 30 1983

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SUMMARY

This report is the second in a series of major reports that will be published in conjunction with the Solid Waste Management and Resource Study for the State of Montana. This report summarizes the potential markets for the materials which can be recovered from the solid waste generated in the state. Generally, there are two types of recoverable materials found in solid waste: 1) Materials which can be used as a fuel to generate steam, electricity and/or heat and 2) secondary materials which can be reused.

From the waste composition investigations it was determined that 77% of the wastes which are processable is combustible and can be utilized as an energy source. Based on an average heat value of 5000 Btu/pound, the 355,000 tons of combustible material generated in the state has an equivalent heat value of approximately 3,550,000 MCF of natural gas and 222,000 tons of Eastern Montana coal.

To determine the potential revenue solid waste may have when utilized as an energy source, it is important to consider the availability and price of the type fuels solid waste could replace. In most instances, the ideal situation is to replace solid waste with a fuel which is high in price and relatively unavailable. Listed below is a summary of the value solid waste would have if it was to replace each fuel which is presently being utilized in the state.

Fuel	Unit Heating Cost	*Solid Waste Worth
Montana Coal	$0.63/MMBtu	$6.30/ton
Wyoming Coal	$0.95/MMBtu	$9.50
Natural Gas	$0.72-1.30/MMBtu	$7.20-13.00
No. 2 Fuel Oil	$2.73/MMBtu	$27.30
Propane	$4.13/MMBtu	$41.30

* Represents wastes which are processable

Prior to utilizing solid waste as an energy source, the waste must be processed. The degree and methods of processing usually depends upon the market in which the solid waste is to be used. Through modern technology the utilization of solid waste can be accomplished by three basic methods: 1) The use of processed waste as a primary fuel source to generate steam, 2) the use of processed solid waste as a supplemental fuel in combination with other fossil fuels, and 3) the use of gases and/or oils obtained from pyrolyzing solid waste. In most instances solid waste is initially shredded. The ferrous materials are then extracted using magnetic belts or pulleys. Then, depending upon the final use, the waste material components are either further processed or directly utilized in an existing or new boiler.

To identify potential users of processed solid waste as an energy source, several methods were employed to obtain information regarding the present and potentially future energy users. The methods used included questionnaires to large industrial consumers of energy, interviews with the various fuel suppliers in the state and on-site interviews and field trips. As a result of the investigations, it was determined that several large energy users in the state are potential markets for solid waste energy. Figures II-3 through II-7 identify the users with the most potential. A detailed analysis of each is included in Part Two of this report. Included in Appendix A is a listing of the potential users which were investigated.

After reviewing the many solid waste processing systems and items of equipment currently being marketed or under development, it became apparent that a large array of secondary products could conceivable be recovered from the solid waste generated in the state. Basically, these products fall into six major categories: 1) Ferrous metals, 2) non-ferrous metals, 3) unsegregated metals, 4) glass, 5) paper products, and 6) agricultural products.

Several sources of information were used to identify potential buyers of the alternative products which could be recovered. Initially, inquiries were made to several national industrial and trade associations requesting their assistance in identifying members who might be considered as potential buyers of these products. As the list of potential buyers grew (being augmented from many sources), specific inquiries were formulated and sent to each potential buyer identified. In addition to the inquiries made by letter and phone conversations, several of the more prominantly known buyers of potential products were visited and interviewed by the Consultant.

From the investigations it was determined that real markets exist for the ferrous and non-ferrous metals which are presently being disposed of. The primary markets for these metals are national industries which are presently purchasing large quantities of recovered metals from solid waste processing plants located throughout the Country. Also, state-wide scrap dealers have indicated an interest in purchasing these metals.

There are national markets for the glass cullet material which can be remelted for the manufacture of new glass containers. The nearest markets to Montana are located on the West coast. In order to meet the specifications set forth by the glass manufacturers, extensive processing of the waste is necessary. The processing techniques which are required are for the most part still unproven. Thus, it is the Consultant's conclusion that the costs associated with this processing be justified prior to purchasing glass separation equipment.

From the inquiries made, it was determined that the potential marketability of the recoverable paper products found in the state's solid wastes is not favorable at the present time. This is due to the depressed paper market and the high freight rates to the potential markets. Because the majority of the potential markets are in excess of 800 miles from Montana, the freight rates far exceed the value of the merchandise at the present time.

Based on the market investigations, the potential revenue from the marketable secondary materials found in the state's solid waste stream was determined. Included herein is a summary of the estimated revenues which could be obtained.

SUMMARY OF POTENTIAL REVENUES FROM SECONDARY MATERIALS

Material	Percentage of Raw Waste	Material * Market Value (Dollars/Ton)	Value Per Ton of Processed Waste
Ferrous	7.9	$15--27	$1.19--2.13
Aluminum	1.3	$200--340	$2.60--4.42
Glass	5.7	$ 1--3	$ 06--0.17
Newsprint	2.5	0	0
* Cardboard	1.0	0	0
Total Potential Value	--	--	$3.85--6.72

* Anticipated freight rates have been deducted from the present market price.

PART ONE

INTRODUCTION

PART ONE

INTRODUCTION

A. GENERAL.

The primary objective of this report is to identify and evaluate existing and potential markets for recoverable materials in the solid waste generated in the State of Montana. The information obtained from these investigations will be used to determine the potential of implementing resource recovery system(s) in the state.

The potential of implementing a solid waste resource recovery system is directly dependent upon markets for the recoverable materials. Revenues from the recoverable materials must be obtained to offset the processing costs of a resource recovery facility. In most instances, if revenues for the recoverable materials cannot be obtained, other methods of disposal will be more economical.

Historically, and at present the markets for recoverable materials have shown considerable fluctuation. These fluctuations can be attributed to a number of outside forces. Some of these are; 1) supply and demand for specific materials, 2) strikes in virgin materials industries, 3) governmental influence through tax or price incentives, 4) foreign purchases and 5) transportation costs. In general, markets for recoverable materials have shown an upward trend similar to that of most other commodities. Although particular future prices for specific components are difficult or impossible to predict, it would be reasonable to expect this trend to continue. In addition to the economic factors; environmental, technological, political and sociological forces are emphasizing resource recovery as a desirable alternative to conventional solid waste disposal.

The wide fluctuations in price and quantities will be buffered in magnitude and frequency as the market for recoverable materials increases in response to the emphasis on resource recovery. When prices are adequate to make recycling attractive, many individual waste generators practice recycling. When the market drops below a certain economic level, these recycled materials become solid waste and enter the solid waste stream. Compared to the total stream, the changes in quantity are not large, but they are present.

All of the recoverable materials of a given type are not subject to the full fluctuations in market price for that material, nor are they likely to move depending on the demand. Those not subject to fluctuations are the materials that flow under the conditions of a long-term contract. The prices may have a base or floor with an adjustment factor based on the daily market price. As a result, the recycler has a steady outlet for his materials and the user has a steady supply. While long-term contract prices are not absolutely firm, they do exhibit more stability than general market prices.

The recovery of some materials may not be profitable; but it can be a method for reducing the expense of controlling waste material accumulation. In addition, the very act of introducing a large governmentally controlled or sanctioned recovery system can affect the demand for some materials. In some cases, prices may fall with the increased volume; in other cases, because of the potential steady supply, markets may develop where none exist now.

B. TYPES AND QUANTITIES OF RECOVERABLE MATERIALS

An important factor which must be determined prior to the evaluation of the feasibility of a solid waste resource recovery facility is the quantity and composition of wastes which the facility must handle. The incoming quantity of waste is an important factor when determining siting, building and equipment sizing requirements. The composition of the wastes is an important factor when determining the type equipment which will be required.

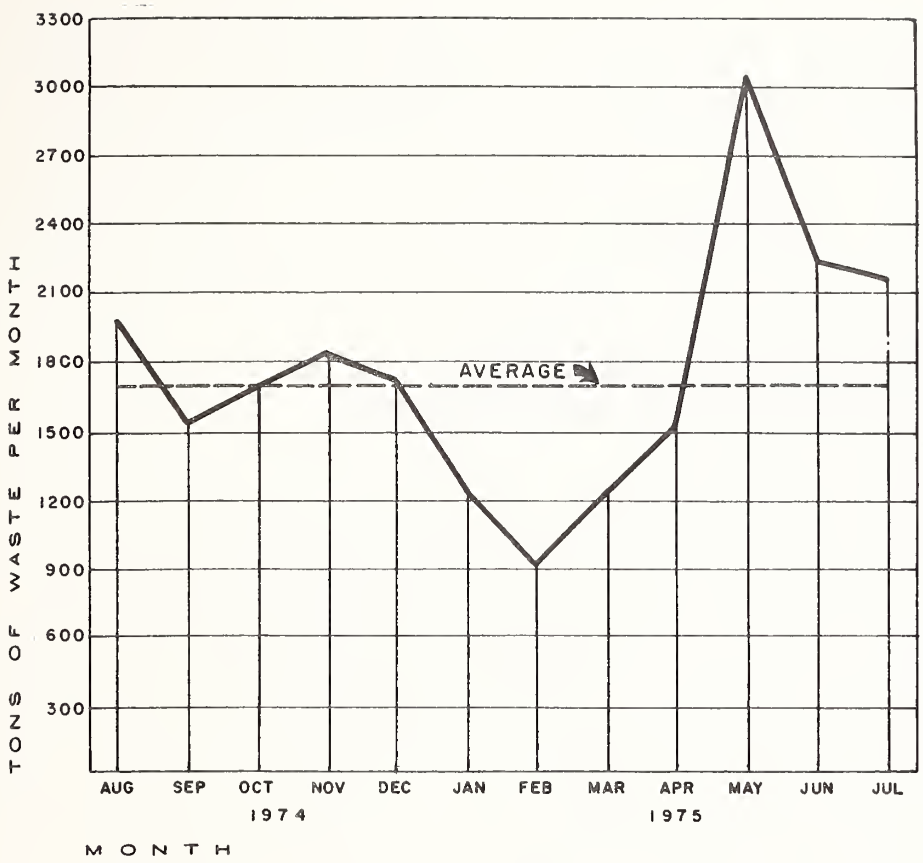
A detailed investigation of the volume and composition of the solid waste generated in the state was conducted during the first phase of this project. The results of that effort were reported in detail in a previous report entitled "Population, Employment and Waste Generation Report" which is on file with the Solid Waste Management Bureau of the State Department of Health and Environmental Sciences. From the detailed investigations, it was determined that approximately 590,000 tons per year of solid waste was generated in the state in 1975. Further analysis showed that approximately 78 percent, or 460,000 tons per year, of the waste could be received and processed at a resource recovery facility. The remaining 22 percent would consist of construction-demolition debris, large bulky items, organic wastes and inert and fill material. Because of their physical characteristics, these type materials would be segregated and recovered or disposed of at separate facilities.

Generally, there are two types of recoverable materials found in processable solid wastes: 1) materials which can be used as a fuel to generate steam, electricity and/or heat and 2) secondary materials which can be reused. The fuel fraction consists predominantly of the mixed combustible fraction of the solid waste stream. Recoverable secondary materials consist predominatly of ferrous and nonferrous metals, separated newsprint and corrugated paper and glass. Specific markets for these potentially recoverable materials are described in detail in this report.

From the waste composition investigations conducted for this project, it was determined that approximately 77 percent of all waste which could be processed is combustible and usable as an energy source. This represents approximately 355,000 tons per year in 1975. This quantity is expected to increase to approximately 484,000 tons in 1990. Based on laboratory testing of solid waste samples in four Montana cities, it was determined that the combustible fraction of the solid waste has an average heat value of 5,039 Btu/pound on as as-received basis. Based on this information the 355,000 tons of combustible material generated in the state in 1975 has an equivalent heating value of approximately 3,550,000 MCF of natural gas or 222,000 tons of Montana coal.

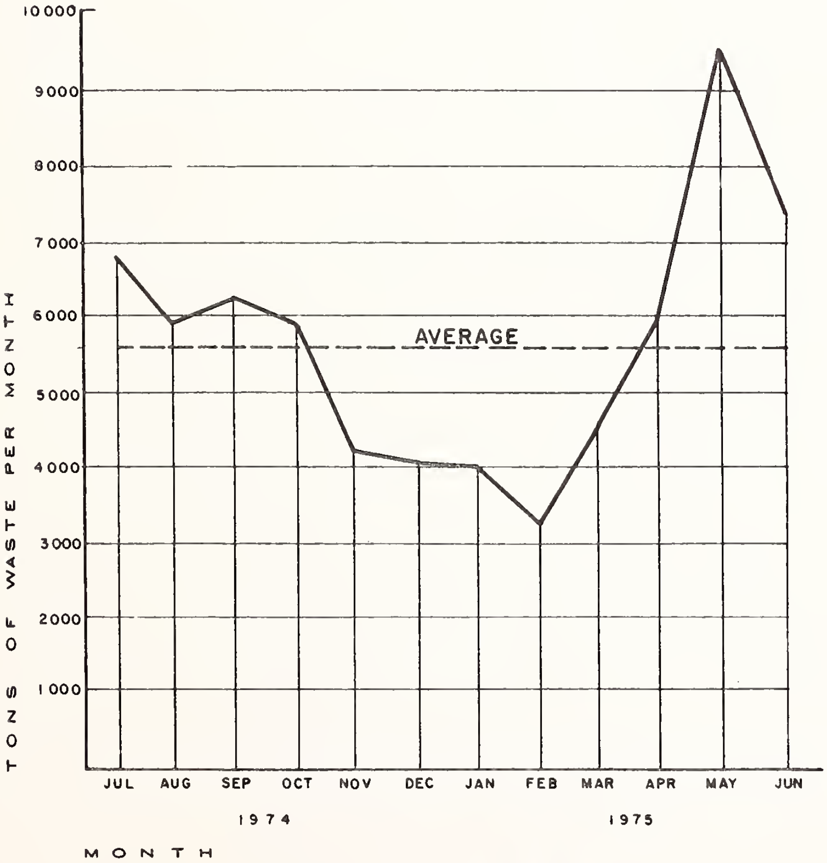
When determining and evaluating potential users of solid waste as an energy source, the availability of solid waste is an important factor. It was determined in the first phase of this project that the generation of solid waste varies considerably from season to season. Figure I-1 summarizes the seasonal variation of solid waste generation for the cities of Great Falls and Helena. In both cities a distinct peak of 60 -- 80 percent above average occurred during the month of May and a peak of approximately 50 percent below average occurred during the month of February. Because of the seasonal fluctuations in solid waste generation, it is important that the quantity of energy which can be derived from solid waste be compared to the energy demand for each potential fuel market to determine if the two are compatible. In many cases the energy demand is highest in the winter months when waste generation is at its lowest. To utilize all of the solid waste, the ideal situation is to locate an energy user which has a fairly constant energy demand which exceeds the energy available from solid waste.

As a practical matter, metals are the only secondary materials which can be recovered and marketed effectively from a resource recovery facility. While the market for waste paper is intermittently favorable; it is also, during favorable conditions, easily prepared, collected and sold prior to reaching the solid waste stream. In most instances once paper is mixed with other refuse, it loses value as a secondary material. Glass can be marketed, but only when prepared to rigid industry standards -- a situation which is not practical at present, although automatic methods for doing so are being developed.



NOTE : DATA OBTAINED FROM CITY OF HELENA

HELENA, MONTANA



NOTE: DATA OBTAINED FROM CITY OF GT. FALLS

GREAT FALLS, MONTANA

SOLID WASTE SEASONAL VARIATION

FIGURE I - 1

The estimated quantity of secondary materials which can be recovered from the state's solid waste stream are listed in Table I-1.

TABLE I-1

ESTIMATED QUANTITY OF SECONDARY RECOVERABLE MATERIALS

Product Category	Tons per Year 1975	 1990
* Paper & Corrugated	16,000	22,000
Ferrous	36,000	50,000
Nonferrous	6,000	8,000
Glass	26,000	35,000

*Represents ten percent of the total paper generated.

PART TWO

FUEL AND ENERGY MARKETS FOR SOLID WASTE

PART TWO

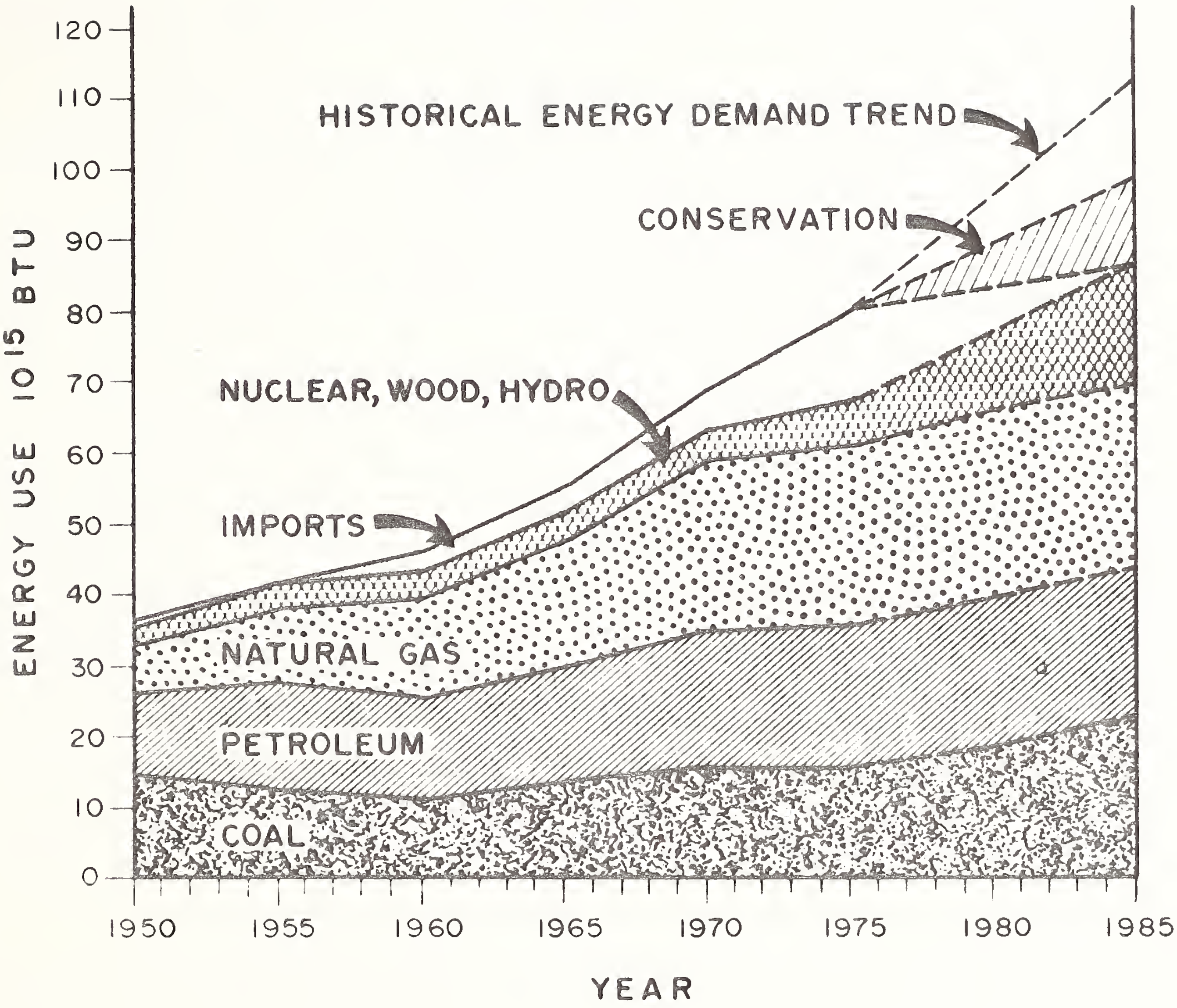
FUEL AND ENERGY MARKETS FOR SOLID WASTE

A. SOLID WASTE FUEL USES.

1. General. Because of the present energy crisis, which is due to the shortage and/or the high cost of conventional fossil fuels such as petroleum and natural gas, alternative fuel sources are being reevaluated or developed. Solid waste is receiving increasing consideration in this regard because it is available, plentiful in urban areas and it can be processed for use as a fuel. Throughout North America and Europe it is being demonstrated that solid waste can be processed and used as a source of energy, either alone or in combination with other fossil fuels.

One of the primary considerations in utilizing solid waste as an energy source is to locate or develop energy markets which fit other problem constraints. Those constraints are primarily: 1) the market must have an adequate fuel demand to make it economically worthwhile to install the necessary processing and firing equipment and 2) the market must have an agreeable attitude toward the utilization and pricing of a new energy source. It was with these constraints in mind that the major energy users in the State of Montana were investigated. These major markets are reported herein.

It is not anticipated that the energy available in solid waste would be used for small-independent energy systems such as home heating. It must be recognized, however, that there is a limited total quantity of energy from all of the combined-presently usable energy sources and that any conservation of fuels through the development and utilization of new energy sources has a positive long-range effect on the total energy picture. If, for example the energy in solid waste can be substituted for the natural gas or fuel oil used by a large industrial user; theoretically, the fossil fuels which that industrial user would normally employ are conserved for other purposes -- including home heating. The amount of energy available in solid waste, while it can be an important factor on the local scale relative to a specific user, is a very small quantity relative to the total energy demand in the United States. The historic energy demand in the United States as well as known and projected available energy supplies are shown in Figure II-1. Also shown is the projected impact of the individual conservation measures which are currently being promulgated in the country. It will be noted that even with conservation there is a definite



SOURCE (CITIZEN'S ADVISORY COMMITTEE ON ENVIRONMENTAL QUALITY)

NOTE:
1950 - 1975 ACTUAL
1975 - 1985 PROJECTED

U.S. ENERGY BALANCE
RESOURCES AND RESERVES

FIGURE II - 1

energy gap in the immediate future. Solid waste can help to close that gap; but in no way can it completely satisfy the needs.

2. Potential Users. Through modern technology the utilization of solid waste as an energy source can be accomplished by three basic methods: 1) the use of processed solid waste as a primary fuel source to generate steam; 2) the use of processed solid waste as a supplemental fuel in combination with other fossil fuels and 3) the use of gases and/or oils derived from pyrolyzing solid waste. Each method is summarized herein:

a. Solid Waste as a Primary Energy Source. Within the last ten years several facilities in the United States and Europe have been designed and constructed to utilize solid waste as the primary fuel source to generate steam. The more prominant facilities in North America are located in Nashville, Tennessee; Saugus, Massachusetts; Hamilton, Ontario and Harrisburg, Pennsylvania. In most instances, when solid waste is utilized as a primary energy source, the boilers are specifically designed to burn solid waste. The degree of processing prior to firing the waste may be quite extensive or may be minimal, depending on the type of boilers and on the ultimate use of the steam. Frequently, only primary shredding and ferrous removal will be required. In order for the utilization of solid waste as a primary energy source to be economical, it is generally necessary to locate the steam plant in close proximity to the customers in order to minimize line losses and the initial investment in the distribution system.

b. Solid Waste as a Supplemental Fuel. A relatively new concept in the recovery of energy from solid waste is the use of the combustible fraction of solid waste as a supplement to fossil fuels in power plants and large industrial boilers. Facilities located in St. Louis, Missouri and Ames, Iowa have been constructed and have proven this concept to be economical, technically feasible and environmentally desirable. The degree of supplement in these facilities has ranged from 10 to 50 percent of the energy requirements depending upon the firing conditions and type of boilers. Results to date have indicated that supplemental solid fuel can be fired with coal without encountering combustion problems.

For solid waste to be used as a supplemental fuel, it must be processed to whatever degree is compatible with the specific boiler to be used. Minimal processing requires that the refuse be shredded and separated into a light combustible fraction and heavy noncombustible fraction. Processes have been developed to shred and separate combustibles as fuel for suspension-fired utility boilers, pressurized fluid-bed combustors or pyrolysis converters. The shredded light combustible fraction can also be pelletized for grate-fired industrial furnaces or for ease of transportation and storage for use in suspension-fired furnaces and pyrolysis systems.

c. Pyrolysis of Solid Waste. Pyrolysis is the fractional distillation of carbonaceous matter to form char, liquids, gases and ash. It is similar in theory to incineration in that both employ combustion as their main operation. Incineration utilizes combustion in an excess of free air which is highly exothermic and produces primarily heat, carbon dioxide and water vapor. Pyrolytic reactions, however, are conducted in the absence of oxygen or in a controlled oxygen deficient environment; therefore, product composition can be regulated.

Several types of pyrolysis processes are presently being used to produce fuel gas, oil and char from solid waste. The Monsanto "Langard" system burns the pyrolysis gases to produce steam which is sold to available markets. Union Carbide Corporation has developed a process called "Purox" which produces a gas comparable to natural gas in combustion characteristics but with a lower heating value (300 Btu per cubic foot). Other pyrolysis systems produce an oil which can be substituted for fuel oil.

There are some drawbacks to pyrolysis systems. The net energy recovered from solid waste is usually less than in direct fired systems. For instance, if solid waste is pyrolyzed, energy is lost in the fuel gas conversion and then again in steam production. The total efficiency is approximately 50% while a typical efficiency in a direct fired system is approximately 70%. Other drawbacks include the limited distribution capability of pyrolysis gas and the composition of pyrolysis oil. One reason for this is that pyrolysis gas contains water and particulates; and it is not suitable for pipeline transport. Generally, pyrolyzed gas can be distributed through pipeline, but only for a distance of 1 to 2 miles.

The present technology of pyrolysis processes is still in the final development stage. It does, however, appear to be a very promising method for the future extraction of energy from solid waste.

B. POTENTIAL REVENUE FROM SOLID WASTE.

To determine the potential revenue solid waste has as an energy source, it is important to consider the availability and price of the fuel(s) solid waste would replace. In most instances, the ideal situation is to substitute solid waste for a fuel which is high in price and relatively unavailable. These situations increase the demand and projected value of the solid waste as a fuel source. In Montana the two major fuel sources currently being utilized are natural gas and coal. To a lesser degree, No. 2 fuel oil and propane are also being utilized. Included herein is a brief summary of the availability and price of each of these fuels.

1. Natural Gas. There are two primary natural gas distribution companies in Montana; the Montana Power Company (MPC) and Montana Dakota Utilities (MDU). Generally, the MPC distributes natural gas in the western two-thirds of the state and MDU distributes gas in the eastern one-third. Included herein is a brief review of the prognosis for the continued availability of natural gas supplies for major users and the approximate pricing structure for each of the two major natural gas distributors.

a. Montana Power Company. In meetings with MPC, it was indicated that they import approximately eighty percent (80%) of the natural gas which they distribute to their customers. The gas is imported from Canada and is controlled by two contracts with Canadian gas exporters. One contract will continue through 1986. The other contract expired in 1974 and is being renewed on a year to year basis. As a result of the primary dependence on imported gas and on the short-term contracts which MPC has with the exporters, the availability of natural gas to MPC customers in the future is unpredictable. Because of these circumstances MPC is not, at the present time, accepting any new industrial gas customers. In addition, they have indicated to their major gas customers there is a definite possibility that all or part of their present gas demands may not be met in the future. The continued availability of gas from Canada will, of course, determine the ability to meet demand. Montana Power Company has also indicated that in the event of curtailment from Canada, their residential users will be given top priority for continued service.

In January, 1975, the rate for natural gas imported by MPC from Canada was approximately $1.00 per MCF. Since then the price has risen to $1.60 per MCF. Because of the increasing cost of imported natural gas and other operating costs, the MPC has petitioned the Public Service Commission for a rate increase, A final agreement as to the exact percent increase that will be allowed is still pending. It should be noted that large industrial users which have natural gas contracts with MPC are currently paying an average of approximately $1.30 per MCF.

b. Montana-Dakota Utility Company . MDU is in a very enviable position relative to most natural gas distributors in the United States. MDU controls most of the gas which it distributes and has major reserves for meeting future firm commitments. The utility does, however, recognize that their reserves are not inexhaustible, and for that reason they initiated in 1974 a policy of not accepting new industrial gas users which would demand more than 36 million cubic feet per year. They also recognize that it may be necessary at some point in the future to curtail all industrial gas customers. This curtailment would generate sufficient quantities of gas to supply residential demand in the foreseeable future. The continued availability of natural gas to MDU customers, even though MDU controls significant reserves, is also likely to be predicated on national concerns and legislation. It is not beyond reason to expect that there will be a national policy of curtailment to large industrial users in order to insure the continued availability of natural gas for residential heating.

MDU officials reported that the average rate for gas paid by MDU's industrial customers in 1975 was approximately $0.70 per MCF. This rate represented an approximate 38% increase over 1974. At the present time, future price increases are difficult to predict, except to recognize that the price is likely to continue to rise.

2. Coal. The most available fuel in Montana on a long-term basis is coal. In addition to the state having an abundant supply of coal, its' neighboring states to the south are also blessed with large quantities of coal reserves. There are basically two types of coal available to users in Montana. These are Eastern Montana coal and Southern Wyoming coal. The major differences between the two types of coal are the heat content and price. Eastern Montana coal has an as-received heat content of approximately 8,000 Btu/pound whereas Southern Wyoming coal has a heat content of approximately 10,500 Btu/pound. The price of Montana coal delivered to a city located in central Montana is approximately $10.00 per ton. This price includes $6.00 per ton paid at the mine, $1,50 per ton production tax and $2.50 per ton for freight and handling. It is estimated that a ton of Wyoming coal shipped to the same location in Montana would cost the user approximately $20.00 per ton.

In addition to the price, the availability of coal was analyzed. Through our investigations it was determined that the majority of the coal producers in Montana are equipped to fulfill the coal requirements for only those users which utilize large quantities of coal. This is primarily due to the strip mining techniques which are employed in the state. Based on these conditions there are very few energy users in the state that would be considered by the coal producers in Montana as a potential market situation. Therefore, it can be assumed that the availability of Montana coal to energy users in the state at the present time is uncertain. Because of the smaller size operations and techniques used to mine coal in Southern Wyoming, the potential of energy users in Montana utilizing Southern Wyoming coal as an energy source are good at the present time. Through our market analysis it was determined that three industries in the state have or are considering converting from natural gas fired to coal fired boilers to generate steam. In each instance it is the present intention to utilize Southern Wyoming coal.

3. Fuel Oil and Propane. The availability of fuel oil and propane is relatively good. The majority of large energy users in the state do not, however, use these type fuels due to their high costs and the problems associated with storing, handling and utilization. Fuel oil is used in Montana primarily as a standby fuel in case of a sudden natural gas curtailment. The price of fuel oil in the last six-month period has stabilized considerably. The current price of No. 2 fuel oil in Montana is approximately $0.38 per gallon.

At the present time very little propane is being used in the state. The majority of the propane customers are very small energy users when compared to the larger industrial energy users in the state. Many propane consumers include citizens who are located in remote areas of the state where natural gas and fuel oil are difficult to obtain. The major reason the large industrial users do not burn propane is that the price is extremely high when compared to other type fuels. The current price of propane is approximately $0.38 per gallon.

4. Revenues From Solid Waste. Based on the present prices determined to be applicable in the state, the unit heating cost (cost per MMBTU) for each of the alternative fuels available in the state was determined. Table II-1 summarizes the unit heating cost of each type fuel. The unit heating cost of each fuel was determined by dividing the present market price by each fuel's unit heating value.

TABLE II-1

ALTERNATIVE FUEL COSTS

Fuel Type	Market Price	Unit Heating Value	Unit Heating Cost
Coal	$10.00/ton	8,000 Btu/lb	$0.63/MMBtu
Eastern Montana	$20.00/ton	10,500 Btu/lb	$0.95/MMBtu
Southern Wyoming	$0.72--$1.30/MCF	1,000 Btu/CF	$0.72--$1.30/MMBtu
Natural Gas	$0.38/gal.	139,000 Btu/gal.	$2.73/MMBtu
No. 2 Fuel Oil	$0.38/gal.	92,000 Bru/gal.	$4.13/MMBtu

As Table II-1 shows, Montana coal is the least expensive fuel in the state with a unit heating cost of $0.63 per MMBTU. This is approximately one-seventh of the highest price fuel-propane. The table also indicated that the price of Southern Wyoming coal is approximately 50 percent more expensive than Eastern Montana coal. It should be kept in mind that the price shown in the table for Eastern Montana coal represents the present price which is being paid by users which purchase extremely large quantities. It is likely that if Eastern Montana coal is marketed to potential users in Montana, the unit price would be difficult to determine at the present time. The actual price Montana users could purchase coal from Eastern Montana producers will depend upon the quantity purchased. In most cases, however, the price to Montana users would probably be higher than the price which is being paid by the extremely large users presently purchasing the coal. This is due to the decreased efficiency of mining, handling and transporting the coal when smaller contracts must be fulfilled.

Based on the unit heating costs developed in Table II-1, the present worth of utilizing solid waste as an energy source was determined. The present worth of solid waste depends directly on the fuel in which solid waste replaces. Thus, the present worth of solid waste was determined for each type of fuel presently being used in the state. Table II-2 depicts the value of solid waste if the waste were to replace each type fuel. Basically, the present worth of solid waste was determined by multiplying the unit heating cost of each type fuel by the average heating value of solid waste. For this analysis a heating value of 5000 Btu/pound, (which is equivalent to 10MMBtu/ton) for solid waste was used. This heating value was determined by laboratory testing of 50 random samples of solid waste obtained from four cities in the state during the initial phase of the project. A detailed analysis of the laboratory results of the solid waste sampling program is included in the first report filed in conjunction with the project, entitled "Population, Employment and Waste Generation Report."

TABLE II-2

PRESENT WORTH OF SOLID WASTE

Fuel Replaced	Unit Heating Cost	Potential Solid Waste Worth
Eastern Montana Coal	$0.63/MMBtu	$6.30/ton
Southern Wyoming Coal	$0.95/MMBtu	$9.50/ton
Natural Gas	$0.72--$1.30/MMBtu	$7.20--$13.00/ton
No. 2 Fuel Oil	$2.73/MMBtu	$27.30/ton
Propane	$4.13/MMBtu	$41.30/ton

As Table II-2 indicates, one ton of solid waste is worth approximately $6.30 for each ton of Montana coal it replaces. The present worth of solid waste increases proportionally as it replaces higher priced fuels. For example, solid waste is worth approximately $27.30 per ton when fuel oil is being replaced. Thus, it is economically advantageous to locate markets for the utilization of solid waste as an alternative energy source when the more expensive fuels can be replaced. It should be noted, however, that it is logical to compare the present worth of solid waste with only those fuels which solid waste can practically replace. Because industries, which are the likely candidates to utilize solid waste as an energy source, are not using large quantities of fuel oil and propane. At the present time, it is not practical to assume that a credit comparable to the unit price of fuel oil or propane could be obtained.. Thus, the potential present worth of solid waste should be limited to the comparable price of replacing coal and natural gas.

It should also be noted that before a solid waste resource recovery facility can be implemented, a long-term contract must be obtained with a fuel consumer. The contract should be based on the present market values of alternate fuels and should also include an esclation clause to account for increasing processing and transportation costs.

C. IDENTIFICATION OF POTENTIAL FUEL MARKETS

To identify potential users of processed solid waste as a fuel source in Montana, three methods of obtaining information regarding the present and potentially future energy users in the state were utilized. Initially, a questionnaire was sent by the State Solid Waste Management Bureau to all industries in the state with ten or more employees. The questionnaire, in addition to addressing the solid and hazardous waste disposal problems of each industry, inquired as to their fuel and energy requirements. Figure II-2 illustrates the section of questionnaire that pertains to the energy and fuel requirements. Returned questionnaires were then evaluated by the Consultant to determine which industries may be applicable for utilization of solid waste as an energy source. These industries were then visited and representatives of each industry were further interviewed so that a more detailed analysis of their particular energy and fuel requirements could be made.

A second method utilized to determine potential energy markets was to contact representatives of the Montana Power Company and the Montana Dakota Utility Company and to obtain a list of each company's larger natural gas customers. Each of the larger users were then contacted to determine their energy requirements. The users with the most potential were them visited and interviewed.

STATE OF MONTANA INDUSTRIAL WASTE QUESTIONNAIRE

Part I - General Information

Name of firm ______________________________

Address ______________________________

____

Principal products produced ______________________________

Average no. of employees ______________________________

Person completing this form: Name ______________________________

Title ____________________ Phone ____________________

Part II - Energy Facilities and Requirements

A. List the approximate quantities of each of the following types of fuel that your firm or plant uses annually:

1. Natural gas (CF) ____________________
2. Fuel Oil (gal) ____________________
3. Coal (tons) ____________________
4. Propane (CF) ____________________
5. Other (specify) ____________________

B. Approximately what percent of the fuel listed above is used for:

1. Heating and cooling ____________________
2. Process steam ____________________
3. Electricity ____________________
4. Other (specify) ____________________

C. For each boiler located on your firm's site, please complete the following:

	Boiler Type	Capacity	Year Installed	Hr./wk. Operated	Type of Fuel(s) Utilized	Is Ash Handling Equip. Installed?
1.						
2.						
3.						
4.						

D. Are any additional boilers planned for the near future? Yes ___, No ___.

1. If yes, how many? ____________________
2. What types and capacities? ____________________
3. Type(s) of fuel which will be used ____________________
4. Approximate installation date(s) ____________________

FIGURE II-2

The third method utilized to determine potential fuel markets was through interviews with various state, county and city officials and interested citizens. Throughout the market investigations local officials in the state added valuable information and suggestions which led to the location of potential users of solid waste as an energy source.

For the consultant to determine which alternate energy users in the state were potential solid waste users and warranted in-depth evaluation, certain operational criteria were determined for these basic user in which solid waste may be utilized as an energy source. The criteria used for this project is summarized in the following three paragraphs.

1. Generation of Steam from Solid Waste. Under typical conditions, when solid waste is utilized as a primary energy source, a new boiler is designed and constructed to fire primarily solid waste. The Consultant has determined this is not practical and economical when less than 250 to 300 tons per day of waste can be utilized. Thus, during the market analysis the Consultant analyzed only those energy users in the state which are utilizing a minimum of the equivalent of 300 tons per day of solid waste.

2. Solid Waste as a Supplemental Fuel. Through technology it has been determined in most instances that solid waste cannot be processed and utilized as a supplemental fuel economically when less than 125 tons per day of solid waste is processed. Current testing and technology has also determined that potential problems may arise when more than approximately 50 percent of the total energy requirements are supplied by solid waste when waste is used as a supplemental fuel. Thus, the Consultant analyzed only those energy users in the state which are utilizing at least the equivalent of 250 tons per day of solid waste as a potential market for solid waste utilized as a supplemental fuel.

3. Pyrolysis. The smallest pyrolysis plant being marketed is a 250--300 ton per day unit. This size unit would produce approximately 7.6 million cubic feet of fuel gas per year, assuming that each ton of solid waste will yield 7 million Btu's of fuel gas. This fuel gas has a lower heating value of approximately 300 Btu per standard cubic foot. Assuming that natural gas has a heating value of 1,000 Btu per SCF, an equivalent of 760,000 MCF per year of natural gas could be produced from a 300 TPD pyrolysis unit. It must also be recognized that fuel gas produced from pyrolysis has definite storage and transportation limitations. For these reasons, the Consultant analyzed only those single energy users or clusters of establishments located within a two mile radius of each other which could utilize a minimum of 760,000 MCF of natural gas per year as a potential market for solid waste utilized as a pyrolysis gas.

In addition to minimum operational criteria, the Consultant also evaluated the potential energy which could be obtained from solid waste on a regional basis. Table II-3 depicts the approximate quantities of waste and the corresponding equivalent quantities of steam, natural gas and coal the utilized solid waste could generate or replace for each planning region in the state.

TABLE II-3

AVAILABLE ENERGY FROM SOLID WASTE

Planning Region	Processable Solid Waste Generated (Tons/Day)	Equivalent		
		Steam (Lbs/Hr)	Natural Gas (MCF/yr)	Coal (TPD)
I	132	39,000	340,000	80
II	301	88,000	770,000	190
III	294	86,000	750,000	185
IV	365	100,000	930,000	230
V	294	86,000	750,000	185

Based on the operational criteria of the various type solid waste resource recovery systems and the quantities of solid waste available in the various regions in the state, energy markets for processed solid waste were evaluated. Included in this section of the report is the results of the market investigations. The market investigations are summarized according to Planning Region. Figures II-3 to II-7 depict the locations of potential users of solid waste as an energy source for each region.

REGION ONE:

1. Steam Markets. There is no application for this alternative in the region.

2. Supplemental Fuel Markets. There are two potential applications in the region. These applications are discussed herein.

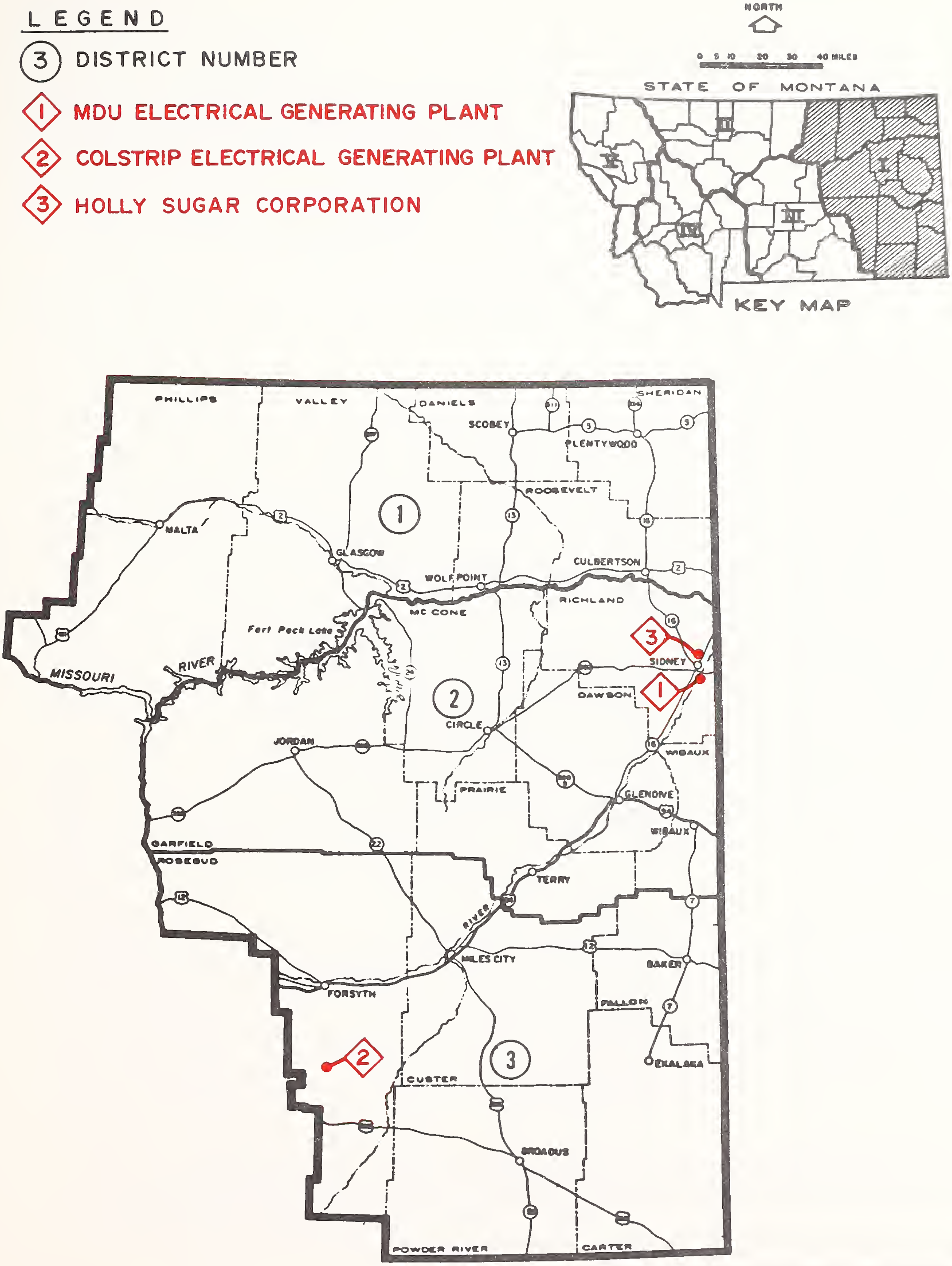
a. MDU Electrical Generating Plant. The Montana Dakota Utilities Company is operating an electrical generating plant in Sidney. The plant includes a 50 megawatt tangentially-fired boiler which is operating at approximately 47 megawatts. The plant is being utilized as a base load facility to supply electricity to MDU's grid system. The boiler at the plant is coal fired and utilizes approximately 300,000 tons per year. The coal is being transported from a mine located near Savage, approximately 25 miles southwest of Sidney. The coal being utilized has a heating value of approximately 6,500 Btu/lb.

Past technology has proven that processed solid waste can be utilized in tangentially fired boilers to supplement coal as a fuel source. If all the combustible portion of the solid waste generated in the region was utilized as a supplemental fuel at the plant, the solid waste would contribute approximately 12 percent of the plant's energy requirements. Thus, from a technical perspective it appears that the MDU generating plant is a potential market for utilizing solid waste as a supplemental fuel.

b. Colstrip Electrical Generating Plant. At the present time the Montana Power Company and other utility companies are constructing an electrical generating plant in Colstrip. The first phase of the plant, which is nearing completion, will include two 300 megawatt boilers. The boilers will be coal fired utilizing Eastern Montana coal. It is anticipated the plant will be fully operational in 1977. The utilities are planning to construct two additional 700 megawatt boilers at the site. The Montana Department of Natural Resources is analyzing this proposal.

Presently, with very minor modifications, there appears to be no serious problems associated with burning shredded solid waste as a supplement to the Eastern Montana coal in the two--330 megawatt units. If solid waste generated in Eastern Montana were burned in these two units, the solid waste would comprise less than two percent of total energy demand in the plant.

3. Pyrolysis Markets. The only large natural gas user in the region is the Holly Sugar Corporation refinery located in Sidney. The majority of the natural gas is used in three combination fuel-oil gas fired boilers to produce process steam. At the present time the plant operates only 22 weeks per year, primarily during the fall and winter when the sugar beet crop is harvested. Because of its partial use, it is not considered a primary solid waste energy market.



POTENTIAL ENERGY MARKETS FOR REGION NO. I

FIGURE II - 3

REGION TWO:

1. Steam Markets. There is one potential application in the region to produce and market steam produced from solid waste, the Anaconda Copper Plant located in Great Falls. The plant uses approximately 27 million pounds of steam per month. The steam is used for building heat and process steam. The steam is produced by five boilers fired predominantly with natural gas. It has been determined that approximately 50,000 pounds of steam per hour or 36 million pounds of steam per month can be produced from the solid waste generated in Great Falls and sorrounding communities. Thus, the solid waste generated in the Great Falls area could produce enough steam to fulfill 100 percent of the plants steam requirements.

Through discussions with local officials and representatives of industries in Great Falls which consume large quantities of energy, it was determined that there are two additional potential situations where solid waste may be utilized to generate steam in the future. One situation is at Malmstrom Air Force Base. The air base utilized approximately 1,000,000 MCF of natural gas per year of which approximately 40% is used by residents located on-base. The remaining 60% is used to heat the base support facilities and the base hospital. The base has three remote facilities which produce steam. Each facility is fired with natural gas. The largest of the three facilities included three 400 H.P. boilers which have been converted from coal. Because only the hospital and dining room require steam during the summer months, the majority of the boilers located on the base are shut down during this period. Air Force officials at the Strategic Air Command headquarters in Omaha informed representatives of our firm that if the price of natural gas continues to rise, it will become necessary for the Air Force to reevaluate their need to convert to a less expensive fuel. If the Air Force were to consider constructing a solid fuel fired central heating and cooling facility in the future, utilizing solid waste as an energy source would certainly be an alternative.

A second potentially large central steam situation may arise at a new industrial park presently being developed two miles east of Great Falls. Throughout the country it has been proven that central facilities supplying steam to local individual users for heating and cooling are substantially less expensive than each user producing their own. It is the Consultant's opinion that if a central facility is constructed at the industrial park, the possibility of utilizing solid waste as an energy source should be evaluated.

2. Supplemental Fuel Markets. At the present time there are no large facilities in the region utilizing solid fuels as an energy source, nor are there any being planned in the near future.

3. Pyrolysis Markets. There are several large natural gas users in the region which could fire gas generated from the pyrolysis of solid waste. There are, however only two which could utilize all the gas which could become available from a 300 ton per day pyrolysis system. As was stated previously, a 300 TPD pyrolysis unit could produce the equivalent of 760,000 MCF/Yr of natural gas. These two potential users are:

a. Anaconda Copper Company (1,400,000 MCF/Yr. Natural Gas)

b. Malmstrom Air Force Base (1,000,000 MCF/Yr. Natural Gas)

Because the gas which results from the pyrolysis of solid waste cannot be readily transported more than two miles, an attempt was made to locate clusters of large gas users within a two mile radius of each other in the Great Falls area. Listed below are clusters and their corresponding annual natural gas usage:

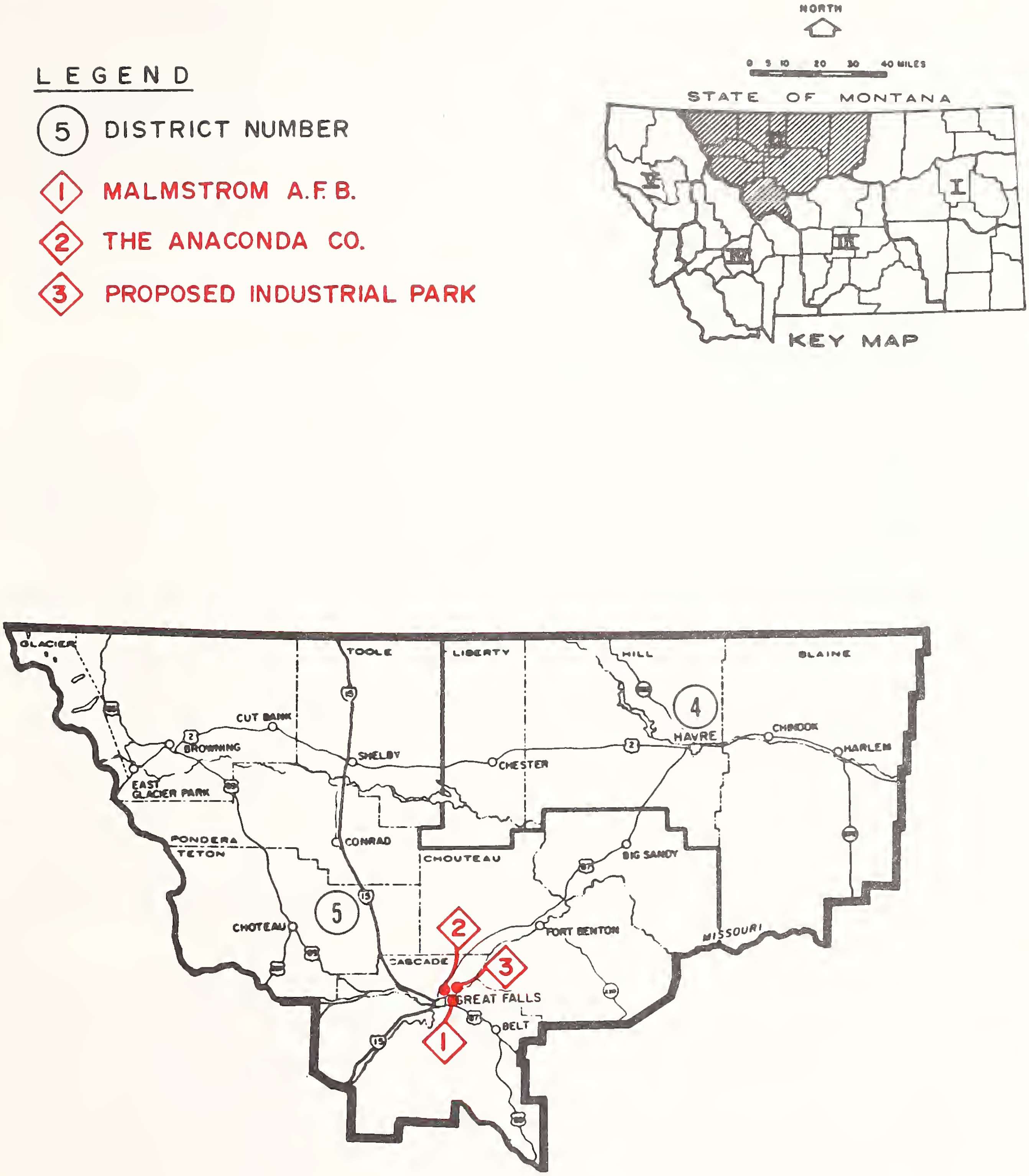
Cluster No. 1

Buttrey's Foods	11,000 MCF
College of Great Falls	33,000 MCF
Deaconess Hospital	40,000 MCF
TOTAL..........	84,000 MCF

Cluster No. 2

New Sewage Treatment Plant	50,000 MCF
Phillips Petroleum Company	300,000 MCF
TOTAL.........	350,000 MCF

Because of the unavailability of clusters of large natural gas users in the region, it is evident that only the Anaconda Copper Company and Malmstrom Air Force Base are potential markets for fuel gas produced from the pyrolysis of solid waste.



POTENTIAL ENERGY MARKETS
FOR
REGION NO. II

FIGURE II - 4

REGION THREE:

1. Steam Markets. In the region there are three large steam users which are potential customers for steam which could be produced from a steam generating plant fired with solid waste. There is also a third potential situation consisting of four large energy users located within two miles of one another in the City of Billings, which could in the future utilize steam produced from a centrally located steam plant.

These potential steam markets are summarized herein.

a. Continental Oil Company. The Continental Oil Company operates an oil refinery in the City of Billings. The refinery produces gasolines, distillates and road oils. The refinery utilizes in excess of 200,000 pounds per hour of steam of which approximately 37 percent is used for process steam and the remaining for heating and cooling. The steam is generated onsite utilizing four water tube boilers varying from 90,000 to 115,000 pounds per hour capacity. Annually, the refinery utilizes 1.6 million MCF of natural gas, 5.6 million gallons of fuel oil, 41 million cubic feet of propane and 4.6 billion cubic feet of waste refinery gases.

Refinery personnel have indicated that if natural gas becomes unavailable or increasingly expensive, the refinery will be required to consider alternative fuel sources to produce the required volume of steam. They have also indicated that a coal fired steam plant at the refinery is being considered. Because of the large steam demand and the increasing costs of fossil fuels, the potential for construction of a solid fuel boiler which could utilize solid waste to generate steam is good. If approximately 300 tons per day of solid waste were utilized at the refinery, the solid waste would constitute less than 15 percent of the refinery's total energy demand.

b. Cenex Oil Company. The Cenex Oil Company operates a refinery in Laurel which produces propane, gasoline, burner fuel, diesel fuel and asphalt. The refinery is generating in excess of 200,000 pounds of steam per hour of which approximately 50% is used for heating and cooling and the remainder for process steam. The steam is generated by use of seven boilers varying in size from 10,000 pounds/hour to 100,000 pounds/hour. The type of fuels which are used include natural gas, fuel oil and refinery gas.

Refinery personnel indicated that the refinery is reducing the use of steam and is increasing the use of electricity predominantly due to economics. They also, however, indicated that the refinery's steam demand for "in-house" steam is still approximately 200,000 pounds per hour. Thus, the use of 300 tons per day of solid waste to generate steam would constitute less than 20 percent of the refinery's energy demand.

c. Exxon Company, U.S.A. The Exxon Oil Company is presently operating a refinery East of Billings. The refinery utilizes in excess of 200,000 lbs. of steam per hour of which 60% is used for heating and cooling, 25% for process steam and 15% for operation of power turbines. The steam is produced by use of four water tube boilers varying in size from 90,000-224,000 lbs/hr. The major fuels used at the refinery are refinery gases, natural gas and fuel oil. It is interesting to note that if 300 tons per day of solid waste were utilized at the refinery to produce steam the solid waste would comprise less than 15 percent of the refinery's total energy demand. Because the refinery's boilers are not adaptable to utilizing a solid type fuel, a new boiler(s) would be required if solid waste were to be used. Refinery personnel have not indicated any plans to convert to a solid fuel boiler at the present time.

d. Cluster of Energy Users. There are four energy users in the north central section of Billings which utilize large quantities of natural gas. They include the Deaconess Hospital, St. Vincents Hospital, Eastern Montana College and Rocky Mountain College. The Deaconess Hospital has two 450 Horsepower package boilers fired by natural gas with fuel oil as a standby. The monthly gas consumption is fairly constant throughout the year becuase steam is also utilized for air conditioning as well as heating. The hospital uses approximately 52,000 MCF of natural gas per year.

St. Vincents Hospital has two 20,000 pounds/hour water-tube boilers. The boilers are gas fired with fuel oil standby. When the new hospital expansion program has been completed, it is estimated that during the winter months the steam demand will approach 20,000 pounds per hour. Because the expansion will be air conditioned, it is anticipated that the summer steam demand will be in the 10,000 to 15,000 pounds/hour range. The hospital utilizes approximately 37,000 MCF of natural gas per year. This is expected to increase substantially when the new expansion has been completed.

Eastern Montana College has no central steam plant. Each building is equipped with its own individual small natural gas fired package boiler. Because of the increasing costs of natural gas, officials of the Montana University System are seriously considering constructing a central steam plant at the college for the purpose of heating and cooling the buildings on campus. They anticipate the plant would be fired by solid fuel. The university officials are applying to the Montana legislature to obtain funds for such a project.

Rocky Mountain College also does not have a central heating and cooling plant. There are currently 14 boilers located throughout the campus heating 16 buildings. All boilers are fired with natural gas. Representatives of the college indicated that due to lack of funding there are no plans to convert to a central steam facility at this time. They did, however, express interest in purchasing steam, if such a plant were constructed in the area.

Based on the energy demands of the four users, there is a possibility a central steam plant could be utilized by all four. Before such a commitment could be made, however, an in-depth study should be made as to the actual steam demands and economics of such a system.

e. Other Potential Applications. The alternative of the Pierce Packing Company and the Midland Packing Company utilizing steam produced from solid waste at a new central steam plant located near the two was also evaluated. From the analysis it was determined that the solid waste generated in the planning district could produce approximately 50,000 to 70,000 pounds per hour of steam at a new steam plant. Because the combined steam loads of the two plants range from 20,000 to 50,000 pounds per hour, depending upon the season, it was determined that this situation is not applicable at this time. It should be realized, however, that if the two company's steam demands should increase substantially in the future, using solid waste as a source of energy for the two plants could definitely be an alternative.

2. Supplemental Fuel Markets. There is one potential application for use of solid waste as a supplemental fuel in the region. This is the Montana Power Company, Corette Generating Plant located in Billings. The plant is utilized as a base load facility and is averaging approximately 150 megawatts.

The primary fuel for the Corette Plant is Eastern Montana coal which has a heating value of approximately 8000 Btu/lb. The plant utilizes an average of approximately 60 tons per hour of coal on a 24 hour per day basis. The Corette plant is also capable of firing natural gas. Natural gas is used primarily to stabilize the flame in the boiler. If all the combustible portion of the solid waste generated in Billings and the surrounding counties was utilized as a supplemental fuel at the Corette plant, the solid waste could contribute approximately eight percent of the plant's energy requirements.

3. Pyrolysis Markets. The only potential individual establishments which utilize a sufficient quantity of energy to be considered as a viable market for the off gas produced by a pyrolysis system are the Cenex Oil Refinery located in Laurel and the Continental & Exxon Oil Refinery located in Billings. Listed on the next page are the approximate quantities of fuel each utilizes:

LEGEND

⑥ DISTRICT NUMBER

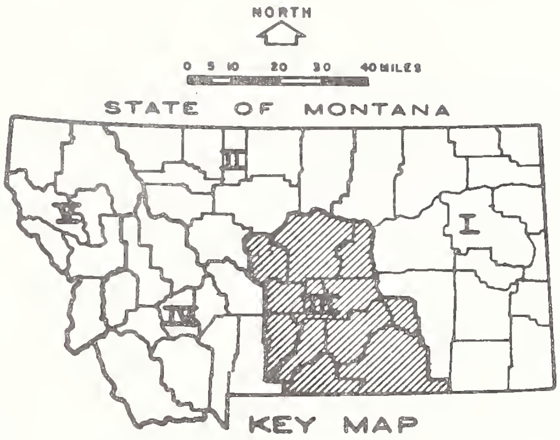
1 CONTINENTAL OIL CO.

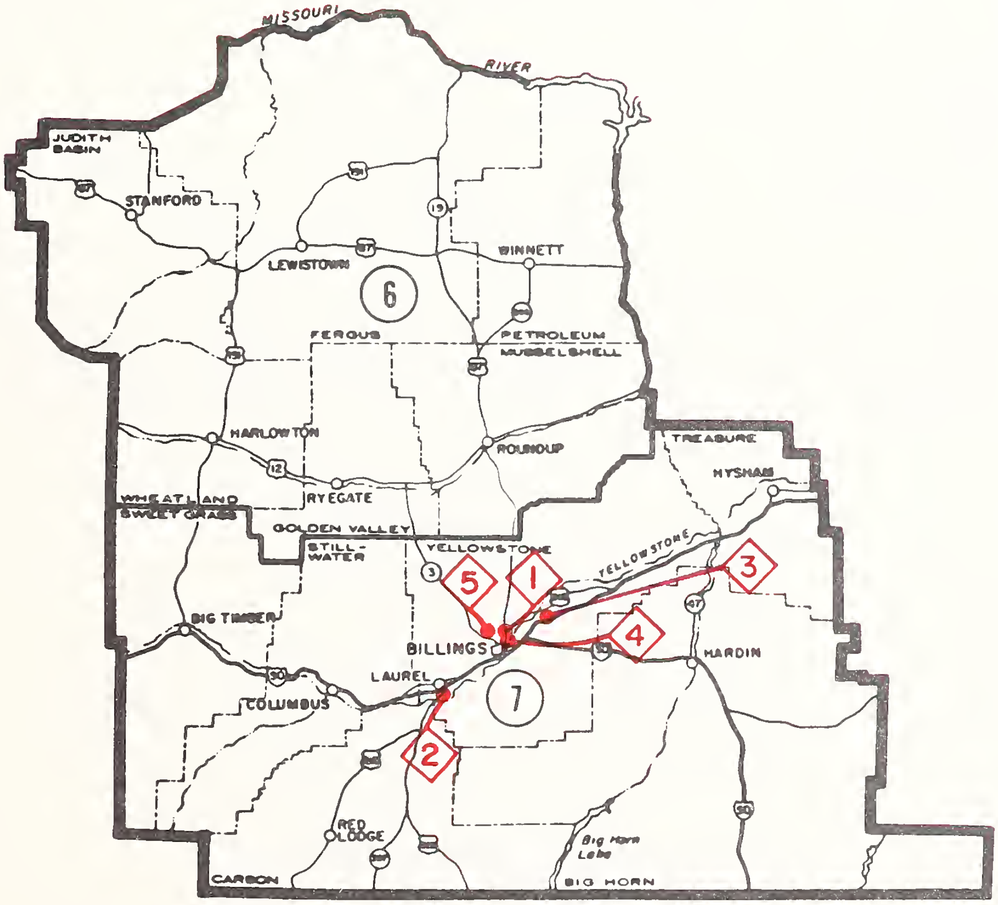
2 CENEX OIL CO.

3 EXXON CO. U.S.A.

4 MPC ELECTRICAL GENERATING PLANT

5 CLUSTER CONSISTING OF;
EASTERN MONTANA COLLEGE
ROCKY MOUNTAIN COLLEGE
ST. VINCENTS HOSPITAL
DEACONESS HOSPITAL





POTENTIAL ENERGY MARKETS
FOR
REGION NO. III

FIGURE II - 5

a. Cenex Oil Refinery

Natural Gas	2.0×10^6 MCF/Yr
Fuel Oil	1.9×10^7 MCF/Yr
Refinery Gas	1.9×10^6 MCF/Yr
Propane	6.5×10^3 MCF/Yr

b. Continental Oil Refinery

Natural Gas	1.6×10^6 MCF/Yr
Fuel Oil	5.6×10^3 Gal/Yr
Refinery Gas	4.6×10^6 MCF/Yr
Propane	4.1×10^4 MCF/Yr

c. Exxon Company U.S.A.

Natural Gas	1.6×10^5 MCF/Yr
Fuel Oil	1.3×10^7 Gal/Yr
Refinery Gas	4.0×10^6 MCF/Yr
Petroleum Coke	109,000 Tons/Yr

There are also two clusters of natural gas users in Billings which could use pyrolysis gas as a substitute for natural gas. However, they do not have the energy demand to utilize all of the gas produced from a 300 ton per day pyrolysis system. These clusters are summarized below:

a. Cluster No. 1	Annual Natural Gas Consumption
Eastern Montana College	93,000 MCF
Rocky Mountain College	46,000 MCF
Deaconess Hospital	52,000 MCF
St. Vincents Hospital	37,000 MCF
TOTAL	228,000 MCF

b. Cluster No. 2	Annual Natural Gas Consumption
Pierce Packing Company	187,000 MCF
Midland Packing Company	67,000 MCF
TOTAL	254,000 MCF

REGION FOUR:

1. Steam Markets. There is one definite potential application in the region to utilize the steam produced from primarily solid wastes, the Montana State University campus. The campus, located in Bozeman, consists of 35 major buildings and 31 small buildings and has an enrollment of approximately 8,500 students. A central heating plant furnishes steam through an underground distribution system to all campus buildings with the exception of a few small storage buildings.

The central plant consists of three natural gas fired steam boilers. It is anticipated that the boilers will consume approximately 495,000 MCF of natural gas during the 1975/1976 fiscal year. Two of the boilers are rated at 50,000 pounds/hour and one at 100,000 pounds/hour. They were installed in 1959, 1960 and 1969 respectively. One 50,000 pound per hour boiler is equipped to fire light oil fed from a 20,000 gallon underground fuel tank on an emergency basis. The boiler feed system has a total capacity of 150,000 pounds/hour; the ultimate design output of the plant. The highest peak of steam ever generated was 115,000 pounds/hour. None of the boilers are adaptable for coal firing.

The Director of the MSU physical plant has indicated that the university is planning to convert to coal fired boilers in the future. He indicated that the conversion will take at least five years. The estimated cost is approximately $2.5 million.

Preliminary estimates show that approximately 30,000 tons per year of Colstrip coal (8,000 Btu/lb) would be required to meet Montana State University's heating demand, based on today's energy consumption. If the new steam plant were to be fired with solid waste, the waste generated in the Bozeman area could contribute approximately 80% of the university's current energy requirements. This would represent approximately 115 tons of solid waste per day--seven days a week.

Because the existing facility is used primarily for heating purposes, very little steam is required in the summer months. In order for solid waste to be utilized as an energy source, a relatively constant energy demand is desirable. Therefore, if the university is to utilize solid waste as an energy source in the future, the university should try to stabilize its' steam demand. This could be done by utilizing the proposed solid fuel fired steam plant for cooling purposes in the summer and also to consider using an extraction turbine to generate electricity.

2. Supplemental Fuel Markets. There are two potential markets for use of solid waste as a supplemental fuel in the region. They both are plants which produce Portland Cement. It is important to note that the composition and grade of particles is critical to the quality of cement; thus, the effects of firing solid waste in cement plant kilns is highly important. Studies are currently being conducted at several cement plants to determine the beneficial and/or detrimental effects of firing solid waste with coal. The data from these tests will be an important factor in determining the potential for utilizing solid waste as a fuel source in cement plant kilns. It is anticipated that data from these testing programs will be available in the near future. The two potential markets are summarized in the following:

a. Ideal Basic Industries. Ideal Basic operates a plant at Trident which produces Portland Cement. The plant utilized 1.9 million MCF of natural gas in 1975. Because of the increased costs of natural gas, the plant is in the process of converting the kiln from natural gas to coal. The conversions will be completed during the spring of 1976.

Officials of the plant have indicated that the coal to be utilized will be Wyoming coal, which has a heating value of 10,500 Btu/lb. Because of the high temperatures which are required in the kiln, it is not feasible to use low Btu Montana coal as a primary fuel source. It could be possible, however, to use Montana coal to supplement the higher Btu Wyoming coal. It is estimated that the plant will utilize approximately 325 tons per day of the Wyoming coal.

If the total quantity of the combustible fraction of solid waste generated in Planning Region IV was utilized to fire the Ideal Basic Cement Plant kiln, the solid waste could contribute approximately 50% of the total energy requirements of the plant. If only the combustible portion of the waste generated in the Bozeman -- Three Forks area was utilized, the waste would contribute approximately 16% of the plant's energy requirements.

b. Kaiser Cement & Gypsum Company. The company is operating a Portland Cement plant in Montana City which is located six miles south of Helena. The plant utilized approximately one million MCF of natural gas per year. Because of the increased price of natural gas and the possibility of being curtailed from the use of natural gas in the future, the plant has developed a contingency plan to convert to the use of coal for their future energy requirements. The plant is on a "wait and see attitude" pertaining to the conversion.

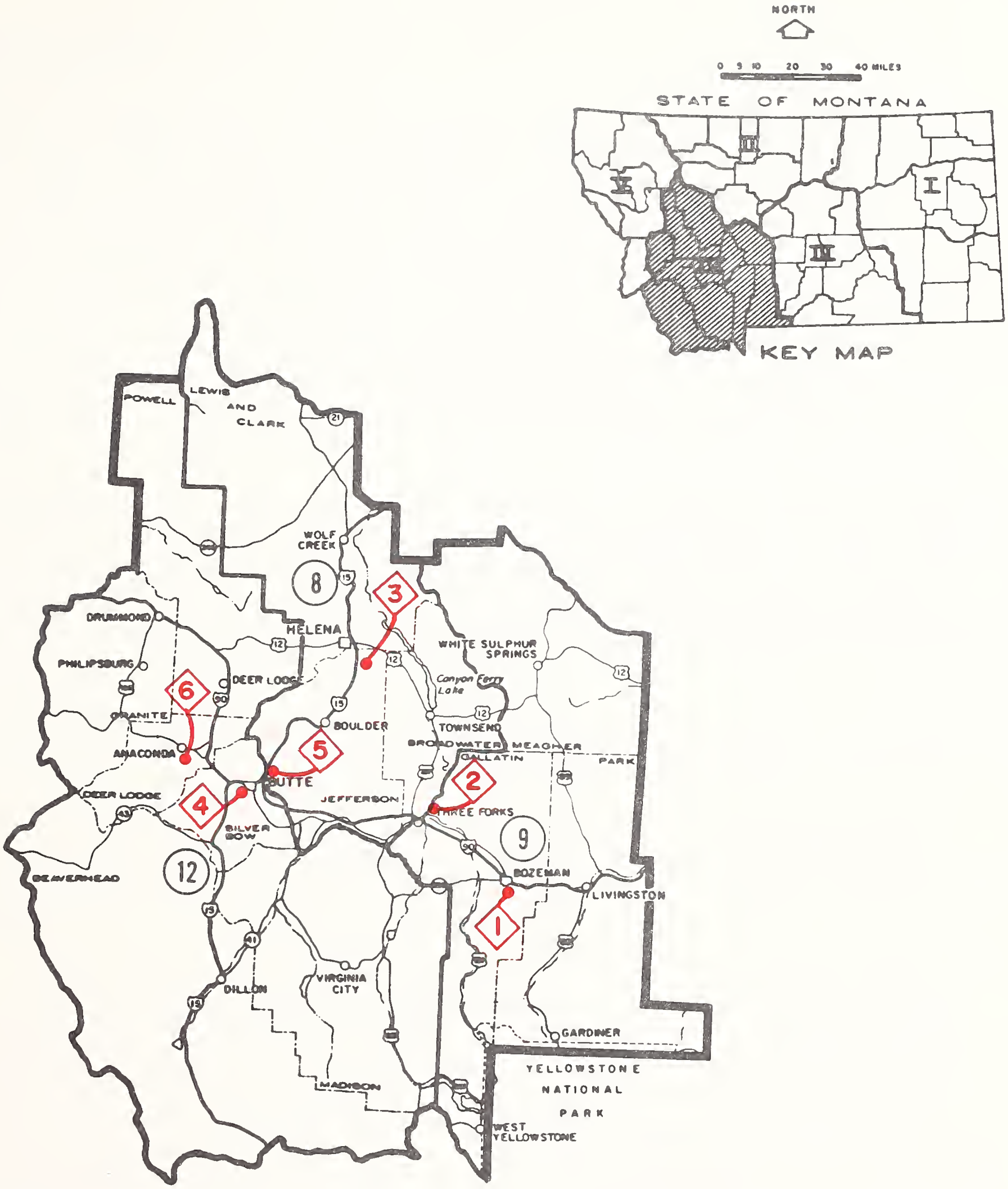
Plant engineers have estimated that if the plant is converted to coal, approximately 80,000 to 90,000 tons per year of 10,000 Btu coal would be consumed. If the total quantity of the combustible fraction of solid waste generated in the region were utilized to fire the cement kiln, the waste could contribute approximately 70% of the plant's energy requirements. If only the combustible portion of solid waste generated in Helena and Butte were utilized, the waste would contribute approximately 49% of the plant's energy requirements. This would represent approximately 180 tons of waste per day -- seven days per week.

3. Pyrolysis Markets. There are three establishments in the region which utilize a sufficient quantity of natural gas to warrant the possibility of utilizing the off-gas from a 300 ton per day solid waste pyrolysis unit. These include the Stauffer Chemical Company located in Butte and the Anaconda Copper Company plant's in Butte and Anaconda and the Kaiser Cement and Gypsum Company. These potential markets are summarized herein:

a. Stauffer Chemical Company. The primary purpose of the plant is to produce Elemental Phosphorus. The plant utilized approximately 760,000 MCF of natural gas and 150,000 gallons of fuel oil annually. The natural gas and fuel oil are used primarily for process steam although approximately 13% of the energy is used for heating and cooling. The plant utilizes two 16,000 pounds/hour water tube boilers to produce the plant's steam requirements. If the plant utilized all of the off fuel gases generated from a 300 ton per day pyrolysis unit, approximately 90% of the plant's energy demand could be met.

b. Anaconda Copper Company. The Anaconda Copper Company's two plants located in Butte and Anaconda are among the larger natural gas consumers in the state. During the past year the plant located in Anaconda consumed 7,000,000 MCF of natural gas and the Butte plant consumed 730,000 MCF. The majority of the gas consumed at each plant is utilized primarily for heating and cooling associated with the metallurgical process. Very little natural gas at the two plants is utilized for producing process steam. If the Butte and Anaconda plants utilized all of the fuel gas produced from a 300 ton per day pyrolysis unit, approximately 100 percent and 11 percent respectively of each plant's energy requirements could be met.

c. Kaiser Cement and Gypsum Company. In 1975 the plant utilized approximately one million MCF of natural gas for firing their cement kiln. If the low Btu gas produced from a 300 TPD pyrolysis unit were utilized by the cement plant to fire their kiln, the pyrolyzed gas would replace approximately three-fourths of the plant's present natural gas demand. As was discussed previously, however, the company has developed a contingency plan to convert from natural gas to coal, if the situation arises. If this plan is implemented, it is recommended that the company utilize solid waste as a solid fuel supplement rather than converting the waste to a low Btu gas.



L E G E N D

⑧ DISTRICT NUMBER

◇1 MONTANA STATE UNIVERSITY

◇2 IDEAL BASIC INDUSTRIES

◇3 KAISER CEMENT & GYPSUM CO.

◇4 STAUFFER CHEMICAL CO.

◇5 THE ANACONDA CO.

◇6 THE ANACONDA CO.

POTENTIAL ENERGY MARKETS
FOR
REGION NO. IV

FIGURE II - 6

REGION FIVE:

Because Region Five consists predominantly of forested land, the economy of the region is based on the lumber, wood and paper mill industry. The majority of the large energy users in the region consist of lumber, plywood and paper mills. There are several lumber, plywood and paper mills in the region which utilize waste wood (hog fuel) in specially designed boilers to produce steam. The energy requirements of several of the larger lumber and paper mills were evaluated. It was determined that three of these mills have a sufficient energy demand such that it may become feasible to utilize processed solid waste and hog fuel in combination to produce steam.

Through the energy market investigations, it was also determined that two large energy users in the region which are not related to the wood and paper industry are also potential markets for the use of processed solid waste. These include the University of Montana and Anaconda Aluminum Plant. These two are now utilizing natural gas as a primary fuel.

Included herein is a summary of the potential situations in the region in which solid waste may be utilized as an energy source.

1. Solid Fuel Markets. In the region there are five steam users which could utilize solid waste as a primary or supplemental fuel source to produce steam and/or electricity. These are summarized herein.

a. University of Montana. The University, which is located in Missoula, utilizes a central steam plant to heat the majority of the buildings located on campus. The steam plant consists of three natural gas fired boilers. Two of the boilers are rated at 70,000 pounds per hour and the third is a 30,000 pound/hour package type boiler. Very few of the buildings on campus utilize steam for air conditioning purposes. Because of the low requirement for steam, only the 30,000 pounds per hour boiler operates during the summer months. During the 1974/75 fiscal year the central steam plant consumed approximately 323,000 MCF of natural gas.

The Director of the University of Montana's physical plant has indicated that the University is analyzing various alternative solid fuels to fulfill their energy demands in the future. The primary fuels being analyzed include hog fuel, wood wastes and coal. The Director also indicated that a new steam plant would be required to use solid type fuels because none of the present boilers are adaptable for solid fuels.

A study conducted by the Montana State University Chemical Engineering Department in 1975 indicated that it would cost approximately $2.1 million to construct a coal-fired central steam plant. In order for the University of Montana to meet their energy demands, it would require the utilization of approximately 23,500 tons per year of Colstrip coal. On an equivalent heating value basis, this would represent approximately 37,000 tons per year of processable solid waste. This represents approximately 60% of the solid waste being generated in the Missoula area.

If a new solid fuel fired plant was constructed, it may be advantageous for the University to produce steam in the summer to cool all major buildings on campus. It may also be advantageous to include an extraction turbine at the new plant and generate electricity for use at the University. If such a system was determined to be practical and feasible, there is a strong possibility that a large percentage of fuel required by the plant could be supplied by utilizing the combustible fraction of solid waste generated in the Missoula area. Thus, serious consideration should be given to utilizing a boiler which could be base loaded with processed solid waste. It is anticipated that the remainder of the University's energy requirements could then be supplied by coal and/or hog fuel.

b. Hoerner-Waldorf Corporation. The Hoerner-Waldorf Mill, located approximately 15 miles west of Missoula, produces two basic products; linerboard and bleached kraft pulp. The mill utilizes large quantities of steam of which approximately one-third is used to generate electricity and two-thirds is used in the paper milling process. To produce the steam, the mill utilizes seven boilers. Six of the seven boilers are fired by natural gas, fuel oil and/or spent liquor. The remaining boiler utilizes hog fuel (wood wastes) and natural gas. In 1974 Hoerner-Waldorf utilized approximately 4.6 million MCF of natural gas. This represented approximately one-third of the mill's total energy requirements. The mill also utilized approximately 110,000 tons of hog fuel, 115 million pounds of oven dried spent liquor and 172,000 gallons of fuel oil. These fuels represented approximately 9%, 57% and 1%, respectively of the total energy requirements of the mill.

Officials of the Hoerner-Waldorf Corporation indicated that due to the increasing costs of natural gas, the corporation is evaluating the possibility of utilizing alternative fuels. Fuels they are considering include coal, solid waste and additional quantities of hog fuel. The mill is limited to the quantity of hog fuel they may utilize due to the capacity of the only boiler which is equipped to fire solid fuels. In order for the mill to utilize an additional quantity of hog fuel, a new boiler(s) would be required.

If all the available combustible solid waste generated in the region were utilized at the Hoerner-Waldorf Mill, the solid waste could contribute approximately 6$ of the mill's total energy requirements. It is the Consultant's opinion that if a new boiler(s) are constructed, processed solid waste should seriously be considered as a fuel source. It is conceivable that the new boiler could be base loaded with processed solid waste with the remainder of the required energy input supplied by coal and/or hog fuel.

c. Anaconda Company. The Anaconda Company is operating an aluminum plant in Columbia Falls. The primary purpose of the plant is to produce aluminum ingots from bauxite. The ingots are then transported to other plants for processing into a final product. The plant utilized large quantities of natural gas and electricity. The largest single energy source at the plant is electricity. In 1974 the plant utilized approximately 3.2 billion KWH of electricity of which the majority was used to operate the pop lines. The electricity the plant utilizes is purchased from the Bonneville Power Administration (BPA).

Approximately 21% of the plant's gas requirements are utilized to generate process steam. To produce the steam the plant utilizes two 22,500 pound per hour boilers of which one is used primarily for standby. Each boiler is equipped to fire natural gas and fuel oil. In 1974 the plant used approximately 476,000 MCF of natural gas. Officials of the plant indicated that there are no plans at the present time to convert the boilers or purchase new boilers in which a solid fuel would be utilized.

Because of the rising prices of energy sources, it may be advantageous for the plant to consider constructing a solid fuel power facility in the future. In addition to producing steam for processing, heating and cooling purposes, the plant could generate electricity. It should be noted that such a facility could include boiler(s) which would utilize coal, hog fuel and processed solid waste. At the present time these type fuels are the least expensive fuels available to industries and large energy users in western Montana. However, if all the processable type solid waste generated in the region were utilized at such a facility, the solid waste would only contribute a small percentage of the plant's total energy requirements.

d. Plum Creek Lumber Company. The Company is operating a mill in Columbia Falls which produces lumber, plywood, fiberboard and wood chips. The plant consists of three basic phases; a sawmill, plywood plant and medium dense fiberboard plant -- all of which utilize process steam. Approximately 98% of the energy requirements at the plant is utilized to produce process steam. The steam is produced by a Riley spreader stoker, 100,000 pounds per hour boiler, which is fired predominantly by bark and sander dust. The total quantity of steam utilized by the plant varies considerably from winter to summer. The average quantity of steam used in the winter by all three phases is approximately 76,000 pounds per hour. This compares to approximately 45,000 pounds per hour in the summer.

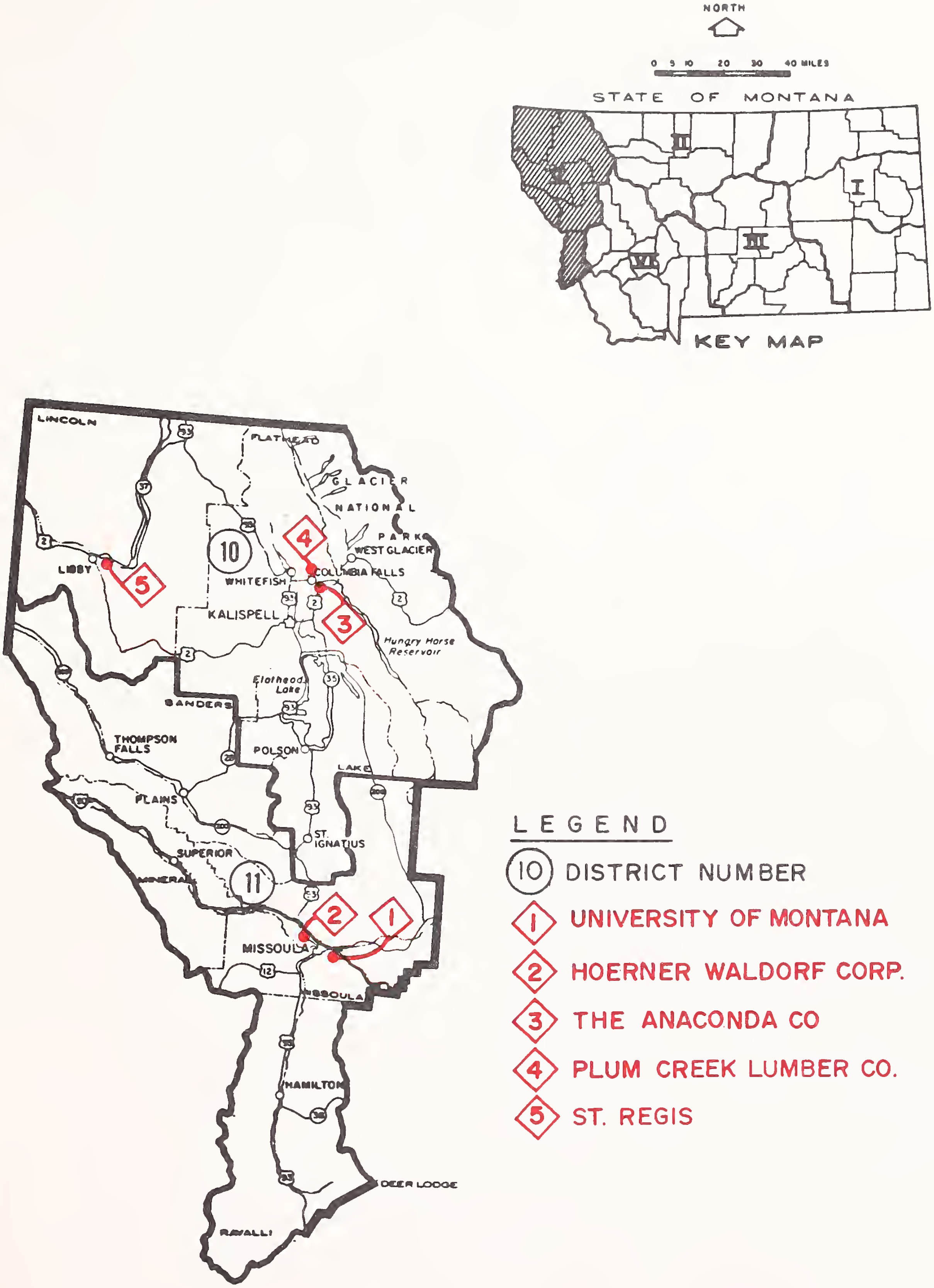
During an onsite visit, officials of the lumber company indicated that approximately 150 tons per day of wood shavings and sawdust are being utilized to produce process steam for use at the medium dense fiberboard plant. This is expected to increase to 300 tons per day in the near future. They are purchasing approximately 50% of the sawdust from a nearby lumber yard. An analysis of past records indicated that the lumber company also uses 1,400 to 2,300 tons of bark per month depending upon availability and steam demand. Officials indicated that approximately 20% of the bark is also being purchased. The current price for the bark which is purchased is $.50 per unit which equals $.04 per million Btu's. Compared to other fuel sources, this appears to be a very economical source of energy for the lumber company.

Based on the current situation, it appears that the lumber plant has a firm, economical source of energy. Thus, it is the Consultant's opinion that it would not be economical for the lumber company to utilize processed solid waste as an energy source as long as wood derived fuels can be obtained at the current price. Solid waste should, however, be considered as a potential fuel source if the availability of the present wood type fuels decrease substantially and the mill is forced to purchase fossil fuels. Based on the mill's present energy consumption, the total quantity of processable solid waste generated in the region could contribute approximately 75% of the mill's energy demands. It should also be noted that processed solid waste could be utilized in the mill's boiler with very little modifications to the existing system.

e. St. Regis. St. Regis operates a lumber and plywood mill in Libby. Because of the unavailability of natural gas in the area and the abundance of hog fuel, 99% of the mill's energy requirements are supplied by hog fuel. Approximately two-thirds of the mill's energy requirements are utilized to produce process steam. The steam at the mill is produced by two dutchovens and a 2,000 Btu spreader stoker boiler. The mill's steam requirements vary substantially from 83,000 to 250,000 pounds per hour, depending upon the season and production level. The steam generation system's capacity is approximately 330,000 pounds per hour. The mill also generates approximately 2.5 million KWH per month of electricity utilizing a 5,000 KW Westinghouse turbine.

Annually, the mill uses approximately 370,000 tons of hog fuel. This fuel posesses approximately the same heating value as processed solid waste (5,000 Btu/pound). Hog fuel, however, has a considerably higher moisture content than solid waste (50% versus 25%). An inspection of the boiler facility at the St. Regis mill indicated that processed solid waste could be utilized with minimal modifications. If all the combustible fraction of solid waste generated in the region were utilized in the boiler, the waste would contribute approximately 29% of the mill's total fuel demand. It should be noted, however, that the mill generates 100% of the hog fuel which is used in the mill's boilers. Thus, for the use of solid waste as an energy source to be potentially feasible, a situation must arise where alternative fuels to hog fuel would be required.

2. Pyrolysis Markets. The only energy user in the region which utilizes a sufficient quantity of natural gas or fuel oil to be considered a potential market for pyrolyzed gas is the Hoerner-Waldorf paper mill located in Missoula. The mill utilizes approximately 4.6 million MCF of natural gas annually. The quantity of low Btu gas produced from a 300 TPD pyrolysis unit would replace approximately 760,000 MCF or 17% of the mill's natural gas demand.



POTENTIAL ENERGY MARKETS
FOR
REGION NO. V

FIGURE II - 7

PART THREE

MARKETS FOR SECONDARY MATERIALS

PART THREE

MARKETS FOR SECONDARY MATERIALS

A. INTRODUCTION

A review of potential buyers for products which might be recovered from the State of Montana's solid waste indicates that real markets presently exist for many products. In other cases, the market will have to be developed before certain products (originating from refuse) will gain widespread acceptance and demand in the marketplace. The recovered material specifications incorporated in this report may seem stringent. However, they are technically attainable, , for a price and must be met if a resource recovery facility is seriously considering selling refuse-derived products to industry. Products compete fiercely in the open market place, and only top quality products will demand the highest price -- or, in case of an economic downturn, find a buyer at all.

In most instances a resource recovery system should be designed with enough flexibility so that if one market fails temporarily, any single unit process can be discontinued or shifted to another market without disrupting the flow of the other system processes. A classic example is the newsprint and corrugated paper market which collapsed several months ago. Almost overnight, products that had sold for $28-$80/ton dropped to $0-$10/ton, and most paper buyers stopped buying altogether because their warehouses were full of used paper products they could not move. During such conditions, it would obviously be useless for the facility owner to continue to recover this product, but it could be rather profitable to divert it to the energy recovery system. Conversely, some operators may choose to continue recovery operations, but stockpile certain products awaiting an upswing in market conditions.

Initially, it was determined to identify all possible products which conceivably could be derived from solid wastes in the state. To this end, all known operational processes were surveyed, as well as those which are currently in the very formative stages of development. As a listing of possible products was defined, alternative buyers of these products were queried.

It became apparent that many of these possible products from solid wastes had never been marketed and hence had never been purchased or used by those potential buyers. Thus, there was a natural hesitancy for the parties concerned to commit to purchasing these materials; and, understandably, they were extremely hesitant to discuss pricing structure. It has been shown historically that, until any product has a track record in the marketplace, most buyers are unwilling to experiment with it. Until the product's performance can be identified and until reliable specifications can be formulated, it remains an interesting speculative product that generates limited interest in the competitive marketplace.

It has been demonstrated that, particularly in the case of secondary materials, new products can be marketed successfully. However, it is necessary to create a demand for a product before the product reaches the marketplace in quantity. To illustrate this, ferrous metals recovered from solid wastes are now in demand by various industries. This demand was created as a direct result of an extensive experimental program financed by industry which developed methods of utilizing these ferrous metals. Thus, only after the performance of the recovered steel product had been adequately demonstrated, was demand created. Then, other potential users (relying on this experimental data) expressed an interest in the product and were able to obtain it in the marketplace. This, in turn, raised the value of the product, which encouraged more cities and solid waste companies to shred solid wastes and recover the steel product. This sequence of events permitted a very favorable marketplace to exist. Some similar market development work may be necessary before many of the new potential products, which are emerging from today's technology, can be marketed successfully in this country.

The basic objective of the product identification and marketing task of this study is to identify the various potential buyers who exist for the products which can conceivably be extracted or produced from solid wastes in the state. The first portion of this task was to identify all such potential buyers on a state level and to determine the ultimate capacity of these buyers to absorb the quantities of materials which might be derived from solid waste. It was then attempted to identify potential markets for the various products on a national level.

As a result of the state and national market investigations, it was determined that markets exist for several of the potentially recoverable materials found in the state's solid waste. Included in the subsequent sections of this report is a detailed analysis of the market investigations conducted.

B. CHARACTERISTICS AND USES OF SECONDARY MATERIALS

After reviewing the many solid waste processing systems and items of equipment currently being marketed or under development today, it has become apparent that a large array of products could conceivably be recovered from the solid waste generated in the State of Montana. In order to explore the market potential of the alternative products more efficiently, these products were grouped and placed into six major categories; 1) ferrous metals, 2) nonferrous metals, 3) unsegregated metals, 4) glass, 5) paper products and 6) agricultural products. The categories were selected to permit a more efficient market research, wherever possible, thus permitting potential buyers to consider groups of similar or related products as a result of each inquiry.

In the succeeding paragraphs the types of buyers and potential uses of the products included in each of the six selected categories are summarized.

1. Ferrous Metals. Basically there are two types of markets for the ferrous metals (large steel cans) recovered from solid wastes: chemical processing and remelt applications. The chemical processing markets include tin recovery and copper precipitation; remelt markets which include steel mills, foundries and ferro-alloy producers. Each market was queried and its' responses are included in this report. Each process, or market specification addresses three parameters: yield, metallurgy and physical characteristics.

"Yield" refers to the amount of iron (Fe) available and is usually expressed as a percentage. The "nonyield" fraction usually refers to the organics or other metallic contaminants in the ferrous metal product. Market value is a function of yield in every case, since buyers are purchasing the iron. Any other materials included represent process contaminants. In many cases low-yield material can be expensive for both buyer and seller, as explained later in the report.

"Metallurgy" refers to the other metals which are plated, physically attached, or alloyed with the ferrous product. The most critical elements of concern are tin, lead, aluminum and copper. Each market has unique metallurgical specifications, although some ferrous scrap can meet more than one of these metallurgical specifications.

"Physical characteristics" refer to the bulk density and/or the size and shape of each individual fragment of ferrous metal. These physical characteristics are controlled completely by the solid waste processing technique selected. Some product specifications require high (70 lbs/ft^3) bulk densities; others insist on a low density product. Normally, density can be increased by shredding and baling and although such operations increase scrap processing costs, the resultant savings in transportation will often offset these costs.

When selling steel scrap, it should be remembered that buyers' prices assume material is delivered to the buyer, and prices are usually quoted on a gross ton (2,240 pounds) basis, rather than a net ton (2,000 pounds) basis.

Each potential market is discussed in the following sections. Included is a description of the process and the applicable material specifications.

a. The Steel Remelt Market. The utilization of steel scrap in the steel-making industry is traditional. In fact, scrap has accounted for 50 percent of the raw material used to make new steel for the last thirty years. About half of the scrap used is generated by the steel mills themselves as "revert". The remainder, about 30 million tons a year, is purchased from outside sources.

The use of steel cans as a scrap material is not new either, but until recently only very small percentages were used for each melt. When national interest in resource recovery increased, the steel industry conducted controlled melting tests to ascertain the most efficient levels for remelting scrap cans in their furnaces. The results were gratifying. At the present time scrap steel cans, which comprise about 90% of the ferrous metals found in municipal residential wastes, can be melted in electric furnaces, basic oxygen furnaces, open hearth furnaces and even blast furnaces.

Probably more external factors affect the market price of steel scrap than any other commodity. Some of these, difficult to control by the steel scrap seller, are short delivery cycles, availability of gondolas, discriminatory freight rates, supply of metallurgical coke and many others .

In addition, the steel companies are concerned with levels of oxidation, nonferrous metals and yield. Oxidation, caused by exposure to the elements or incineration, results in a loss of base metal (iron), thereby reducing (yield) revenue. This should not be a problem in this study since the time interval between disposal and recovery is comparatively short. The presence in the steel scrap of nonferrous metals creates operating problems in the charging cycle and metallurgy. Proper care in the refuse processing cycle will minimize this problem and maintain specification standards.

Yield, of course, is the amount of steel actually recovered during melt and is proportional to the amount of ferrous materials in the product. Steel companies will base their pricing for the product on an anticipated yield. Failure to meet the prescribed percentage will reduce the income to the seller. Thus, if a 50 ton load of "ferrous" products is shipped by the seller to a steel furnace and yield is only 80%, the seller will be penalized the 20% by direct loss in revenue and, in addition, will have paid the freight on 10 tons of nonferrous materials included in the shipment. The steel company will be penalized because of increased charge time, production losses, slagging problems and probably air pollution problems.

If it wishes a guaranteed continuing market, then the seller must consistently deliver the best possible ferrous products to the steel remelt buyer.

Metallurgy: The presence of tin, carbon and copper are the most critical elements of concern. Generally, aluminum slags in processing, but other elements are alloyed. The acceptable levels vary between processes, plants, and type of steel product made. Generally, refuse-derived steel, without detinning, can be used to make most new carbon steel products. Although every type of steel-making furnace can accommodate steel recovered from solid wastes (without detinning), electric furnaces and blast furnaces probably are the most common users.

Physical Characteristics: A high bulk density is mandatory. Many companies insist on bales or bundles and size varies with the individual plant. Some prefer a "nuggetized" or briquetted product; in these cases, steel shredded by an Eidal mill is most valuable. Generally speaking, a bulk density of 75 lbs/ft^3 is required for remelt. Individual company specifications are included with correspondence when available.

b. The Tin Recovery (De-tin) Market. De-tinning is an industrial process which recovers tin from tin-plated steel. The usual sources are cans rejected in the can manufacturing process, cans recovered from municipal solid waste before incineration and other sources. There are about 7-1/2 pounds of tin in each ton of scrap cans. The de-tinning industry is this country's only domestic source of tin. De-tinners, who claim that recovered tin is purer than metal produced from ore, indicate they will buy all the clean, nonincinerated steel can scrap they can get. Basically, tin recovery is an alkaline chemical process in which scrap is treated with a hot caustic soda in the presence of an oxidizing agent, such as sodium nitrate or nitrate, and the tin is dissolved as sodium stannate. The tin is then recovered from the solution as sodium stannate crystals, as metal by electrolysis, or as a tin oxide.

Metallurgy: A high tin content is desirable, and aluminum from bimetal beverage cans can be accommodated only in certain plants. Thus, the presence of heavy metals and aluminum tends to degrade the value of ferrous metals for this market.

Physical Characteristics: The product must not be tightly baled or compressed. De-tinning depends on chemical reaction on the surface of the metal, so a high surface-to-volume ratio is desirable. An ideal product consists of uniformly sized "coupons" of constant thickness.

c. The Gray Iron Foundary Market. Iron foundaries represent an exciting new potential market for ferrous metals recovered from municipal refuse. A research program sponsored by the American Iron and Steel Institute (AISI) recently demonstrated that unincinerated ferrous metals recovered from solid wastes could be successfully used in gray iron foundries using cupolas; successful production tests were run by foundries in Tonawanda, New York; Baltimore, Maryland and Oakland, California. Metallurgical results of these tests are not included as part of this report, but are available from the Consultant if needed by the customer.

Similar tests have been run under AISI sponsorship on incinerated scrap by Professor John F. Wallace at Case Western Reserve University in Cleveland, Ohio, and the results have been very satisfactory.

Metallurgy: Metal contaminants, normally found in refuse-derived steel, can generally be accommodated by foundries making gray (rather than ductile) iron castings. These contaminants are primarily tin, aluminum and lead.

The tin level is sufficiently low that it is not a problem in the production of pearlitic gray iron castings. Aluminum and lead also usually occur in acceptable concentrations.

Physical Characteristics: The product should be shredded and not baled. Although a dense product is desirable, most foundry cupolas cannot accommodate baled material. (Some can accept specially-made small bales). This factor should be evaluated with each prospective buyer of the material to verify specific requirements for baling or shredding, since final processing cost to the local government is a consideration.

d. The Ferro-Alloy Industry Market. A fourth market for refuse derived steel is in the production of ferro-alloys, where iron is combined with carefully controlled amounts of other elements, such as silicone and manganese. The resultant materials are then used as an additive in melts for alloy steel, as castings in foundries and other industrial applications.

One principal ferro-alloy providing a market for ferrous scrap is ferro silicon, in which the iron source is ferrous scrap. Traditionally, either machine shop turnings or incinerator scrap have been used, depending upon the economic factors of supply and demand. However, for metallurgical reasons, incinerator scrap or unincinerated refuse-derived steel normally should not exceed 50% of the input material. For example, about 400,000 tons of ferro silicon are produced each year creating an annual market demand for 200,000 tons of ferrous scrap. Therefore, the resultant national market potential for municipal ferrous scrap is about 100,000 tons annually. This represents a relatively small but interesting market.

Metallurgy: Since elemental iron is the crucial product, "yield" is very important There are, apparently, no problems with the quantities of copper, tin, aluminum, etc., normally found in refuse-derived steel.

Physical Characteristics: The product must be shredded so that it can be used in existing material-handling equipment. This requirement precludes baling. The density of such a product should be as high as possible to minimize long distance rail shipping costs.

e. Copper Precipitation Iron Specification. Reclaimed cans, with all impurities removed, have a ready market in the copper industry as "precipitation iron". The process involves the use of sulphur acid in a chemical reaction which leaches out the copper from low-grade ores in the form of copper sulphate. Basically, a 5 -- 10% solution of sulphuric acid is percolated through a pile of copper-bearing ore. The resultant copper sulfate solution is collected and run into a vat (launder) full of prepared ferrous metal. As iron sulfate forms, spent copper is precipitated in the launder. The solution is recirculated from the launder to the copper ore pile and back again to the launder. The chemical reactions continue (involving ferric, ferrous, cupric and cuprous sulfates) until the supply of iron in the launder has been exhausted and deposited in the ore pile as insoluble iron . The spent copper deposited is washed, decanted and sent to the smelter. This process is one of the few economically feasible ways of recovering copper from low-grade ores. Approximately three tons of ferrous metals are used to produce one ton of copper; this represents a potential ferrous recycling market of 8 billion cans a year or 500,000 tons of ferrous. Because the material must be of low density, transportation rates are comparatively high and close proximity to market is desirable.

Metallurgy: The product must be free of tin, lead and aluminum. Copper presence is not objectionable. The ratio of oxides to ferrous metal is also critical.

Physical Characteristics: The product must not be baled or tightly compressed. The precipitation process depends on the chemical reaction on the surface of the metal, so high surface to volume ratio is desirable. An ideal product consists of uniformly thin "coupons".

f. Secondary Materials Dealers. Scrap metal dealers and brokers in the State represent a large potential market for metals recovered from solid wastes. While this sector of industry is not a final consuming industry, as are the others listed in this category, the scrap metal dealers in a very real sense provide products to all of the consuming industries listed, as well as to export buyers. The importance of this industry to the potential resource recovery facility operator could be significant; scrap metal dealers can provide an extremely useful function as brokers for material which might be recovered from solid wastes. In this role, the dealers could provide ready and continuing markets for metals, process them as required, and resell to any of the ultimate buyers which offered the best current pricing structure. In other situations, the scrap metal dealer could provide additional processing, such as shredding, nuggetizing, baling, detinning and burning which might be necessary to meet the alternate buyers' specifications. In others, the scrap metal dealers could provide a real service in transporting the recovered metals, whether by truck, rail or ship.

Secondary materials dealers will purchase scrap metals of many types, provided that they are generally clean and representative of a good metal product. In some cases, this type of buyer may prefer to broker the material directly to the ultimate user or may process and further beneficiate and accumulate the material before delivering it to the ultimate buyer. In many instances, the secondary materials specifications will be determined by the ultimate buyer and would be so expressed by the secondary material dealer.

2. Nonferrous Metals. Although nonferrous metals comprise a small portion of municipal solid waste (seldom exceeding one percent by weight), once segregated these metals are extremely valuable. If these products are segregated and in a pure form, there are many alternative buyers for them; however, buyer interest depends to a large extent upon the purity of the product and the segregation method used.

Since current technology permits the isolation of an "aluminum only product," alternative buyers for this product have been explored, as well as those for the mixed nonferrous metal product.

a. The Aluminum Market. Aluminum can be removed from solid wastes by mechanical processing after the wastes have been shredded and air classified, and ferrous metals have been magnetically removed. Preferably, the glass and aggregate material should also be removed by screening. In general, there are two distinct types of processes currently being built for the first full-scale resource recovery operations.

One is a wet process which is variously identified as a "heavy," or "dense," media system to float aluminum and thus segregate it from other materials. In this process, finely powdered magnetic ferrosilicia is suspended in water, giving it an apparent high specific gravity (2.8-3.0), which permits aluminum to float on the surface. This is an adaptation of a mineral processing technique that has been widely used for many years. In actual operation on solid wastes, the system requires process water and cleanup provisions for the wastewater and media control are expensive and difficult. The recovered aluminum is a mixture of various aluminum alloys, along with occasional pieces of "pot metal," antimony, and other light metals. The recovered metal also retains some ferrosilica or magnetic residue from the media vessels. In summary, the aluminum thus isolated has value and can be marketed, but the price obtainable reflects the relatively poor quality of the material.

Recently a dry process has been developed and demonstrated successfully on a pilot scale and is not being installed full-scale at the National Center for Resource Recovery facility in Washington, D. C., and at the Ames, Iowa Solid Waste Resource Recovery Plant. A similar type unit will be installed in San Diego, California at Occidental Petroleum's 200 TPD pilot plant. These devices (called eddy current separators or aluminum "magnets") isolate an aluminum fraction made up predominantly of aluminum beverage cans. Since this material is essentially a single alloy, generally uncontaminated by other impurities, its' market value is substantially higher than that produced by the wet process.

Recovered aluminum is currently being purchased by two markets: major aluminum producing companies and aluminum smelters producing specification ingots. Beverage cans separated manually and collected by volunteer recycling groups (as well as aluminum can stock mechanically recovered by the eddy current process) are remelted by the major aluminum companies to make new beverage can stock. Similar remelt markets exist for industrial aluminum scrap which is segregated by alloy.

Mixed alloy aluminum scrap is purchased by aluminum smelters. These dealers melt the scrap and adjust the metallurgy, as necessary, to produce billets of lower alloy aluminum. There are many such smelters in this country and overseas, purchasing industrial scrap and aluminum recovered from car-shredding operations. These buyers can accept the lower purity aluminum recovered from solid wastes by the dense media process. They are also buyers of the high purity material sought by the major aluminum companies.

In addition to these basic markets for recovered aluminum, there are local brokers (scrap dealers) who purchase such material and ship it to whichever basic market offers the highest price at that time.

Metallurgy: Aluminum recovered from waste will meet various industry grades, depending upon the method of separation. A top quality refuse-derived aluminum product should be at least 95% aluminum. Nonmetallics should be minimal because of their effect on yield. The composition of the product should be essentially aluminum cans. A high incidence of other aluminum products will result in down-grading of the material.

Physical Characteristics: Depending upon the buyer finally selected, the product may be shipped loose or low-density baled in rail cars or trucks. (The latter is generally the rule). Material should be dry and covered during shipment. Certain buyers will accept the material, F.O.B. receiving facility, so this point should be clarified early in the program.

b. Mixed Nonferrous Metal Market. Mixed nonferrous metals can be recovered from solid wastes as a byproduct of, or an extension of, aluminum recovery. This mixed metals fraction (generally less than 0.25% of the wastes) consists of minute quantities of copper, lead, zinc, stainless steel, coins, keys, residual aluminum and numerous other metal products that are neither magnetic nor aluminum. Each constituent is valuable in its own right, but extensive further processing to isolate the individual metal is generally not feasible economically even for a major resource recovery system.

Probably, the best outlet for this material would be a local scrap dealer, particularly one operating an auto shredder, and recovering nonferrous as well as ferrous metals. These companies, in turn, may hand-pick some of the higher valued materials such as copper and sell the rest or incorporate the product with a load of nonferrous scrap ultimately scheduled for the export market.

The market is neither strong nor well-defined, but a mixed nonferrous metal product is of interest to the secondary materials industry. The types and quantities of metals present in the product will govern the market value. Analytical assays must be performed before pricing formulas can be established.

3. Unsegregated Metal. Historically, many solid waste disposal operations have recognized that certain bulky metal products, such as appliances, white ware and other heavy metal items have value in the scrap metal market. Generally, these have been segregated manually during, or just prior to, disposal at the landfill site or transfer station and have been marketed successfully to a secondary metals processor for shredding and further processing, in preparation for use by the final consumer of the metal products.

It should be recognized that this concept can be pursued to some extent even in a resource recovery facility. There is always some point during solid waste processing for the recovery of materials, that process economics conclude that the derived product has achieved sufficient purity to be marketable, and that further beneficiation is not justified economically. Our market analyses have shown that, when a product can be derived having characteristics which meet the specifications set forth by the final user, that it is practical for the resource recovery facility to market this product directly to the consuming industry. In the cases where further beneficiation and segregation is required, the most logical outlet for this product is generally the secondary materials industry. Scrap metal processors and dealers in this industry can further refine the metals for use domestically, or export them for further segregation in the Orient.

There are a number of stages in solid waste processing where a non-segregated metal-rich product could be produced. At one end of the spectrum is the virtual complete segregation of products; this still leaves an unsegregated, nonferrous, nonaluminum metal product which is marketed directly to the secondary materials industry. We might define the other end of the spectrum as a condition whereby the resource recovery facility simply shreds and air classifies solid waste to produce a refuse-derived fuel fraction. The other fraction (the air classifier heavies) would contain virtually all of the metals, glass and other heavy organic and inert materials. It is quite possible that it may be practical to market this unsegregated material directly to the secondary materials industry without further processing. In this case, however, the product, although containing all of the metals, have comparatively little value in that form on the open market; thus the price which the secondary materials industry might pay for such a product would be comparatively low. However, the process economics might indicate this to be a very viable solution, in that the resource recovery facility could avoid investing in other processing equipment and thus avoid all of the capital and operating and maintenance costs associated with further processing. From one point of view, virtually any positive value obtained for this type of material would be of benefit since it would offset potential disposal costs associated with landfilling that fraction, if further recovery were not feasible.

4. Glass. Recovered glass can be used as cullet material, which is remelted for the manufacture of new glass containers. This concept has been demonstrated by virtually every glass container manufacturer using glass bottles and jars collected manually and color-sorted by volunteer recycling centers. Such color-sorted used glass is in demand periodically by the glass companies, as a result of their frequent difficulties in obtaining soda ash. Soda ash is a primary additive used to make new glass from silica sand. When soda ash also became a primary new material in the manufacture of the new "biodegradable" detergents, existing mining and rail transport facilities were hard-pressed to meet the sudden surge in demand. Predictably, the price for soda ash rapidly increased.

The net result is that the glass companies have taken a renewed interest in all sources of used glass, attempting to hold the line on glass container production costs. Most individual companies have raised the price of color-sorted glass to $20 or more per net ton (delivered), provided it meets purity and color requirements.

In practical terms, the major technical difficulty for any operator of a resource recovery facility, lies in implementing a system that can meet the purity and color-sorting requirements and accommodate the costs of moving the product to market. An acceptable pure glass fraction can be obtained by mechanical means and/or froth flotation techniques. However, the only mechanized color-sorting technique available is an optical comparator, one form of which is undergoing development testing at Franklin, Ohio. The results, to date, have not been encouraging; the optical sorting equipment is very expensive, requires extensive material preprocessing and reportedly does not reliably segregate glass products which meet specifications.

Recently, a new market has developed for noncolor-sorted, refuse-derived glass. When a glass company has a furnace which produces green or amber glass, some amount of noncolor-sorted glass cullet can be used safely in the mixture. This material is added to the batch up to the "allowable impurity" level, which may be as high as 20 percent of the mix. This material can be derived from refuse using the froth flotation process, which evolved from the mining industry. The Occidental Research and Development Company in LaVerne, California has done considerable testing of this process on a pilot plant scale, and has produced a specification product guaranteed over 99 percent pure, which has been used in the manufacture of new containers. The process is less expensive than color-sorting, but does involve a level of water treatment and media control.

Glass Container Manufacturer's Institute has a glass specification for color-sorted and noncolor-sorted glass. However, since mechanical sorting of glass by color is still developmental, the discussion will be limited to noncolor-sorted material.

The product must be dry (no drainage), noncaking, and free flowing with not over 0.25 percent organics, not over 0.05 percent magnetic material, and maximum size 1/4 inch. The glass mixture itself must be totally soda-lima (container) glass. One hundred percent must pass a 2-inch by 2-inch mesh screen, and 10 percent must pass a 140 mesh screen. Solid inorganics, other than metal or refractory, should not exceed 0.10 percent, maximum 1/4 inch. Refractory and nonmagnetic metals in the +20 mesh range shall not exceed 1 particle in 40 pounds of mix, maximum size 1/4 inch. Basically, the above mixed cullet material can only be used to manufacture amber or green glass.

5. Paper Products. For many years newsprint, corrugated cardboard and mixed office papers have found a market as a source of fibre for the paper industry. About 40% of the material is "converting waste" derived directly from industry and 60% is salvaged from post-consumer waste. Although the annual tonnages of recycled paper have increased, the rate of recovery (as a percentage of consumption), has steadily declined.

Most post-consumer corrugated cardboard and mixed papers are collected by representatives of the salvage industry from industrial and commercial establishments on selected pickup routes. These materials have not been mixed with residential wastes and are usually acceptably clean. If market conditions are reasonably good, hand sorting can be accommodated within the operating margins created by reasonable market prices.

Newsprint can be separated by homeowners and bundles can be collected by regular or modified collection vehicles and by special pickup vehicles; or, they can be collected by civic groups and industry by providing appropriate containers, solicitation through the media and favorable pricing. Generally, the product must be clean, bundled and free of moisture, magazines or other special papers. Industry sanctions this type of operation because they can easily turn the flow of material on or off and to some degree can set the price for the commodity.

Mechanical processing of mixed municipal wastes in large recovery plants is a third possibility and is being tried in both wet and dry processes by such organizations as Black Clawson Company, Forest Products Laboratory, University of California, and Environment Resources Corporation (Darien, Connecticut). However, very little paper recovery presently takes place using these mechanical processes since the recovered fiber is not competitive with the cost and quality of virgin fibers.

A fourth possibility is to process the paper along with the other post-consumer wastes by converting it to some usable form of energy, such as; gas, oil, steam or electrical power.

Waste paper and recovered paper products have been recycled for some years to produce certain other grades of new paper products. Inasmuch as this practice has been well established, specifications and descriptions and the various grades of paper products have been developed and published by the Paper Stock Institute of America in their circular ES-74 entitled "Paper Stock Standards and Practices."

All of the grades of used paper that have been formulated are based upon source separated or hand sorted types of paper. To date, no standards have been established for paper grades which might be recovered by any mechanized process. It is problematical whether any such standards will be developed.

Broadly speaking, there are four general categories of recovered paper products which might be segregated in a resource recovery facility. They are:

a) "Containers", which is defined as old containers, both solid fiber and corrugated and container plant cuttings.

b) "News", which includes newspapers, special news of deink quality, over-issue news, etc.

c) "Mixed papers", includes mill wrappers, boxboard cuttings, and various mixed paper.

d) "Other", includes shavings, envelope cuttings, bleached sulfite-sulfate cuttings, book stock and magazine, news and publication blanks, Kraft paper, including bag and envelope cuttings.

The plants which use waste paper as a raw material are particularly concerned about contaminants such as plastics, metals and oils which have serious impact on the process. Very likely recycled papers could not be acceptable for food packaging applications because of public health concerns.

Some newspapers, which are printed by the offset technique, are more difficult to deink. In some cases, the purchase price is adjusted to reflect this difference in newspaper printing techniques.

6. Agricultural Products. The agricultural products which might be derived from the States' solid wastes include a compost or soil conditioner product as well as a cattle feed substitute or additive. Both products have been produced experimentally from solid wastes in pilot plants which shred solid wastes (and generally remove some amount of metals and inerts), prior to "composting" the organic fraction by using various methods of inducing and controlling aerobic decomposition.

If the process is carefully controlled so that temperatures are retained within prescribed limits and the flow of air (or oxygen) is maintained, a peat-like "compost" product can be obtained. If objectionable "non-compostible" items (including tires, glass, metal cans, foil, razor blades, etc.), are removed at some point during processing, the final product can be marketed successfully as a soil conditioner, which can displace peat moss and similar products from the retail marketplace.

The concept appears to be miraculous when first described, answering all the prayers of environmentalists and conservationists. A number of compost plants have been built in the United States between 1965 and 1975; none have been successful. All have suffered from one or more of the three basic problems associated with composting:

a) The process has a tendency to produce objectionable odors, unless the aerobic conditions are carefully maintained. Many plants have been closed by an irate segment of the population because they were shown to be a nuisance or health hazard.

b) It is difficult and expensive to produce a compost product which is sufficiently free of contaminants to be acceptable to the gardening public.

c) The product has been purchased only by amateur gardeners and has generally not found acceptance for large agricultural applications. The marketplace repeatedly has been shown to be very limited.

Research programs are continuing wherein composted refuse is used as an animal feed. Experiments in Oklahoma have shown that both pigs and steers consumed the "fodder" eagerly when flavorings (such as malt) were added. It was generally concluded that a steady diet of flavored compost would maintain the health and weight of the test animals, but the animals would not grow or gain weight on the diet. This reaction was attributed to that large ratio of inerts (or ash) in the compost, which contribute to the feed bulk and satisfied hunger, but had no nutritive value. Later experiments demonstrated that significant weight gains could be effected by formulating a feed mixture using grain and compost.

Similar test programs are in progress in California and Colorado and, if successful, may have a significant effect upon future cattle feeding practice. Meanwhile, the Food and Drug Administration as well as public health agencies are observing the results and are assaying the potential effect (if any) upon the resultant meat products for human consumption.

In as much as soil conditioner and animal feed derived from composted solid wastes are experimental products at this time; no specifications or standards are currently available. Limited test data and laboratory analyses which described the compost products in detail were made available to the Consultant, but there is no evidence the products meeting this description would be acceptable to a commercial buyer.

C. EVALUATION OF SECONDARY MATERIALS MARKETS

The Consultant utilized several different sources of information to identify potential buyers of the alternative products which could be recovered from the solid wastes generated in the State of Montana. Initially, inquiries were made to several national industrial and trade associations requesting their assistance in identifying members of their associations who might be considered potential buyers for these products. In some instances, the cooperative response from these organizations was quite helpful. In others, no response was received.

As the list of potential buyers grew (being augmented from many sources), specific inquiries were formulated and sent to each potential buyer identified. These inquiries gave the background of this marketing analysis and the specific data which was required to quantify the material specifications, identify the capacity each potential buyer might have for recovered materials and to shed as much light as possible on the pricing structure for these potential products. Three general letters were developed for this purpose. The general categories which the letters covered were: 1) metals, 2) glass and 3) paper products. Copies of the inquiry letters sent to the potential buyers are included in Appendix B.

In addition to the inquiries made by letter and phone conversations, several of the more prominantly known buyers of potential products were visited and interviewed by the Consultant. These interviews and conversations proved to be very helpful and valuable in the overall market analysis.

Included in the following pages of this report is the analysis and results of the market investigations conducted for this project. The analysis is summarized by general material type.

1. Ferrous Metals. Through market analysis it was determined that several potential markets for recoverable metals located in the state's solid waste stream are available. Listed below are national industries which have indicated a desire to purchase a solid waste derived ferrous product from resource recovery facilities. Each of these industries were contacted by letter during the market analysis for this project.

M & T Chemicals, Inc.
Subsidiary of American Can Co.
Rahway, New Jersey 07065

Vulcan Materials
P. O. Box 720
Sandusky, Ohio 44870

Gillerman Steel Trading Company
1629 North Broadway
St. Louis, Missouri 63102

Judson Steel Corporation
500 Sansome Street
San Francisco, California

Kaiser Steel Corporation
300 Lakeside Drive
Oakland, California

Michael Shiavone & Sons, Inc.
Universal Drive
North Haven, Connecticut 06473

Metals Cleaning & Processing, Inc.
8300 West Florist Avenue
Milwaukee, Wisconsin 53218

Bethleham Steel Corporation
Bethleham, Pennsylvania 18015

United States Steel Corporation
600 Grant Street
P. O. Box 26
Pittsburgh, Pennsylvania

From the inquiries made, two companies showed considerable interest in purchasing the ferrous materials which would result from a resource recovery facility in Montana. Those responses are summarized below:

a. Vulcan Materials Company. Vulcan Materials is basically a detinning company with many plants which regularly consume refuse-derived ferrous metals. Vulcan's plant in Gary, Indiana has the most applicability for refuse-derived ferrous materials in the State of Montana. The plant in Gary is presently utilizing this type material and it anticipates no problems in consuming the refuse-derived ferrous from Montana, if its' specifications are met.

On January 16, 1976 our office received a letter from Vulcan Materials indicating their interest in purchasing ferrous from Montana. They also forwarded to us their specification for the ferrous scrap they would purchase. Copies of the letter and specifications are enclosed in Appendix B.

b. M & T Chemicals, Inc. Like Vulcan Materials, M & T Chemicals is a detinning company with several plants located throughout the United States. M & T has, for several years, been a large consumer of ferrous metals derived from solid wastes at their many plants. In January our firm received a letter in response to our inquiry as to the potential of their company purchasing ferrous metals derived from solid waste in the state. M & T indicated that they are prepared to enter into a long-term agreement for the purchase of ferrous scrap. Like most interested companies, the pricing structure will be tied to the appropriate national scrap metal market with a guaranteed return to the facility. Included in Appendix B is a copy of the letter received from the M & T Chemical Company.

In addition to the national markets for the ferrous products, there are also two industries located in the State of Montana which could potentially utilize the ferrous product. These are:

The Anaconda Company
Butte, Montana 59701

American Smelting & Refining Company
East Helena, Montana 59635

The potential of these markets is summarized below:

a. The Anaconda Company. The Anaconda Company is presently operating a copper precipitation plant in Butte, Montana. The plant utilizes approximately 200 tons per day of shredded and detinned ferrous in their copper precipitation process. Officials of the company indicated that they would be interested in purchasing metal from a resource recovery facility in the state, if the material met their specifications.

From representatives of the detinning industry, it was determined that it is not economical to construct and operate a detinning plant unless a minimum of 70,000 tons per year of metal are processed and detinned. It is estimated that in the entire State of Montana's waste stream there are approximately 36,000 tons per year of metals. Thus, unless scrap metals are imported from other states, it is not economical to construct a detinning plant in the state. Officials of the Anaconda Company have also indicated that they are not interested or anticipating constructing a detinning plant for their use. Therefore, it is the Consultant's opinion that the Anaconda Company plant in Butte will be a potential market for ferrous metals derived from the state's refuse stream only if the company's policy changes or a sufficient quantity of refuse-derived metals are imported from other state's such that a detinning plant is determined to be feasible in the state.

b. ASARCO, Incorporated. The company is presently operating a custom load smelter in East Helena, Montana. The principal products produced at the smelter are lead, gold, silver and copper by products. The plant utilizes approximately 200 tons per month of scrap iron to supplement coke in the plant's blast furnaces. The specifications of the metal used require that it be a heavy type steel or cast iron. It is mandatory that the metal utilized be a minimum of one-quarter inch in thickness. The company is purchasing the majority of the iron they utilize from metal and scrap dealers located in the state. Because of the specifications which would have to be met, it is not anticipated that the company would be a potential market for shredded ferrous resulting from a solid waste resource recovery facility(s).

2. Non-Ferrous and Unsegregated Metals. In regards to potential markets for the nonferrous metals resulting from a resource recovery facility, it was determined that three definite national markets exist for the aluminum fraction. As was stated previously, aluminum comprises the largest percentage of the nonferrous metals located in the solid waste stream. These include:

Vulcan Materials
P. O. Box 720
Sandusky, Ohio 44870

Aluminum Company of America
Manager, Resource Recovery
Health & Environmental Dept.
1501 Alcoa Building
Pittsburgh, Pennsylvania 15219

Reynolds Aluminum Company
Manager, Resource Recovery
Programs
Executive Office Building
6601 West Broad Street
Richmond, Virginia 23261

Included in Appendix B is a copy of a letter from each company in response to our market inquiry. Also enclosed is a copy of each company's description and specification for the types of materials they might purchase. It is apparent from reviewing the specifications that each company recognizes that there are at least two different grades of aluminum which can be recovered and that the aluminum beverage can stock is regarded as a premium grade of aluminum.

In addition to the national markets there is one potential state industry which may be able to utilize the aluminum recovered from a state resource recovery facility; the Anaconda Company Aluminum Plant located in Columbia Falls. The plant is purchasing a small quantity of aluminum beverage canw which have been shredded from a nonprofit recycle center located in Kalispell. At the present time, the material specifications and minimum and/or maximum quantities which could be marketed are still being investigated.

In addition to national and state industries which can utilize solid waste derived metals, scrap dealers and brokers located in the state were queried. Listed below are the larger scrap dealers in the state which were investigated.

Custom Balers and Salvagers of
America
West Billings
Billings, Montana 59101

Madison Minerals Corporation
Butte
Montana 59701

Carl Weissman & Sons
300 Third Avenue South
Great Falls, Montana 59401

Pacific Hide and Fur Depot
Iron & Steel Division
201 2 N.W.
Great Falls, Montana 59401

McCracken Metals
631 East Aluminum
Butte, Montana 59701

Compressed Steel
Stevensville
Montana 59870

Montana Steel and Equipment
Highway 93
Kalispell, Montana 59901

Kalispell Wrecking Company
57 Fifth Avenue E
Kalispell, Montana 59901

Bitter Root Metal & Salvage Company
Hamilton
Montana 59840

Of the eight scrap dealers queried, two responded in writing; the Madison Mineral Corporation and Carl Weissman and Sons, Inc. Included in Appendix B is a copy of their letters of response. As each letter indicates both companies are interested in purchasing marketable metals which would become available from a resource recovery facility(s) in the state. Mr. Weissman also included a standard classification for nonferrous scrap metals which was published by the National Association of Recycling Industries, Inc. A copy of the classification is also enclosed.

Through telephone coversations and interviews, it was also determined that the Madison Minerals Corporation, Pacific Hide and Fur Depot and

McCracken Metals are interested in purchasing the nonferrous materials recovered from a resource recovery facility. Each indicated that the exact price would depend on national marketing prices and the product's quantity, quality and composition. It is anticipated that this type material would most likely be contracted for with the company indicating the highest bid.

In addition to the scrap metal dealers in the state, the Montana Recycling Incorporated is a potential market for ferrous and nonferrous metals as well as recoverable papers and bottles. The firm presently operates recycle centers in eight communities in the state. During the period of October 1, 1974 - September 31, 1975, the firm collected approximately 1000 tons of aluminum, 3.8 million returnable beverage bottles and 175 tons of paper. The majority of the paper collected was computer cards. It is interesting to note that the firm collected approximately 16% of the total aluminum disposed of in the state. Because the firm purchases recoverable materials at the centers and in turn sells the materials to industries which reuse the material, it is anticipated that the firm could act as a broker for the secondary materials recovered at a resource recovery facility (s) in the state.

In addition to the Montana Recycling Incorporated, there are other small activities and organizations engaged in recycling throughout the state. It should be noted that these organizations could also act as a broker for the secondary materials recovered at a resource recovery facility (s).

3. Glass Products. As discussed previously in this report, there are markets available in the nation for the glass cullet material which can be remelted for the manufacture of new glass containers. An investigation into the location of glass container manufacturing plants indicated that there are very few glass manufacturing industries in the nation which are near Montana to be considered a potential market for the glass obtained from a resource recovery facility in the state. The analysis indicated that there are two potential glass manufacturing markets in the Pacific Northwest which could utilize glass resulting from a recovery facility located in the state; the Owens-Illinois Corporation located in Portland, Oregon, and the Northwestern Glass located in Seattle, Washington.

A letter was sent to the Owens-Illinois Corporation to determine their interest in purchasing glass from a recovery facility located in Montana. A letter of response was received from the corporation. A copy of the response is included in Appendix B. Included in their response was a cullet specification which their corporation would require. The specification is also included in Appendix B. Through a phone inquiry, Northwestern Glass also indicated an interest in purchasing glass from a recovery facility in the state.

In order to meet the specifications set forth by the glass manufacturers and to isolate a pure enough product which can be marketed, extensive processing of the waste is necessary. The processing techniques required are for the most part still unproven. Based on this, it is the Consultant's conclusion that, for each resource recovery facility, the costs associated with producing a marketable glass product should be carefully evaluated.

In addition to the glass cullet markets there are secondary products which can be produced from disposed glass. The secondary products which have been produced experimentally from recovered glass include foam glass blocks, bricks, glass wool insulation, glassphalt, terrazzo floors, tiles and many other items. Unfortunately, no facility is currently producing any of these products on a regular basis. This is primarily due to the process economics. To compete with sand or gravel costs, the processing costs of the recovered glass would have to range from $3 to $5. Utilizing today's technology this is not possible.

A final alternative is the utilization of screened glass/aggregate products as an aggregate or select fill material. In this alternative a credit of $1 to $3 per ton could be taken for aggregate the glass would replace, rather than absorbing an equivalent cost penalty for hauling and disposing of the product at a landfill. There are, however, processing and handling costs which would be associated with this alternative which would have to be covered by the revenues obtained for the utilized product.

4. Paper Products. A letter of inquiry was sent to several paper and pulp plants which are regular buyers of recovered papers. The plants which were queried are listed below. As the list indicates, there are no present users of recovered paper products located in the State of Montana.

United Paper Stock Company
33 India Street
Pawtucket, Rhode Island 02860

Howard Zuker Assoc., Inc.
875 North Michigan Avenue
Suite 4031/36
John Hancock Center
Chicago, Illinois 60611

National Fiber Supply Company
55 East Monroe Street
Chicago, Illinois 60603

Independent Paper Stock Company
1900 17th Street
San Francisco, California 94103

Friedman &Son, Inc.
2345 Walnut
Denver, Colorado 80202

I. Hershman & Company, Inc.
50 New Street
P. O. Box 538
New Haven, Connecticut 06503

Container Corporation of America
900 Odgen Avenue
Chicago, Illinois 60603

Bruno & D/Elia, Inc.
Paper Recycling Centers
109 McKinley
Hackensack, New Jersey 07602

DeMatteo Salvage Company, Inc.
90 Gleam Street
West Babylon, New York 11704

Fibers, International
P. O. Box 1691
Bellvue, Washington 98004

Northwest Paper Fibers
2625 NW Industrial
Portland, Oregon 97210

Four of the potential markets queried responded by letter. A copy of their response is included in Appendix B. The remainder of the markets were contacted a second time by phone. It was determined that the majority of the potential markets contacted by phone were not interested in purchasing recoverable paper products in the state at this time.

From the inquiries made, it was determined that the potential marketability of the recoverable paper products found in the state's solid waste is not favorable. This is due to the combination of the depressed paper market and the high freight rates to the potential markets. Because the majority of the potential markets are in excess of 800 miles from Montana, the freight rates from Montana far exceed the value of the merchandise in most instances.

It must be remembered before embarking on any venture into the recovered paper market, that only secondary papers of highest quality can consistently bring the top prices in this cyclical marketplace. Certain contaminants such as wax, or hot melts, plastics, styrofoam, asphalt, dirt, garbage, etc. would have a very serious and detrimental effect on the quality of the paper product and hence, the price which might be obtained for it.

Thus, it is a fact of life that the basic industry is primarily attuned to using virgin materials. When demand for paper products is high and the economy is in a very healthy mode, the paper industry will turn to using waste papers and recovered post-consumer papers to make up any deficit in pulp production. Thus, it can be seen that the demand for recovered papers is quite variable and exists only in times of peak production and a healthy economy. As the economy and production and consumption begins to sag, the waste paper market is the first source of fiber which is cut off. Consequently, recovered paper is perhaps the most volatile of the secondary materials commodities.

It is firmly recommended that resource recovery facilities should not base their process economics on paper recovery. It is a product which can be segregated or produced when the market is high and can be explored speculatively when the conditions warrant. However, for the basic process economics, it is firmly recommended that the paper fraction be regarded as a potential fuel commodity rather than a source for secondary fiber.

5. Agricultural Products. An analysis of the markets for agricultural products derived from solid waste in the State of Montana indicated that several potential markets exist. This is due to the large quantities of soil conditioner which is required in the state each year. There are several problems, however, associated with utilizing soil conditioners which are derived from solid wastes generated in the state. The major problem is the economics of such a situation. In order for compost to be utilized as a cattle feed substitute or soil conditioner, the metals and inerts must be removed. This requires a high degree of processing which includes shredding, metals separation and air density separation. Because of the prices of soil conditions in the state, this processed waste is usually worth more as an energy source than as a soil conditioner or cattle feed. A second problem associated with utilizing compost is the minimum size plant available. Under present technology, processing less than 300 tons per day of waste for use as a compostable material is not economically attractive. It is anticipated that this large quantity would probably cause a dislocation in the market place and displace products currently being sold on the retail level.

Based on the market information summarized above, it is the Consultant's opinion that the agricultural products derived from solid waste in the state not be considered to be a highly developed marketable material at this time. In the event that this material achieves recognition and acceptance for large-scale agricultural applications, the picture would change drastically.

D. POTENTIAL REVENUE FROM SECONDARY MATERIALS.

Most potential buyers of secondary materials determine a fair market price for the material by evaluating a sample from the resource recovery system or a prototype thereof. The price established depends on the preparation and the amount recovered after final processing.

Listed in Table III-1 are the market prices for the various secondary materials which can be potentially recovered from the solid waste generated in the state. All prices are delivered prices to the respective markets. As shown, the prices are indicated for both state and national markets. In most instances national markets will be higher than local markets. It should be noted, however, that transportation costs to national markets may overshadow the difference in actual market prices. For example, the cost to ship one ton of material, depending upon the material type, will be approximately $30 from Montana to Chicago and approximately $20 per ton from Montana to the West Coast. Thus, when evaluating the actual value of materials for national markets, the transportation costs should be subtracted from the delivered prices.

TABLE III-1

SUMMARY OF SECONDARY MATERIAL PRICES

Material	Market Price Per Ton (May 1976) State ***	 National ***
Ferrous	--	$45--47 *
Aluminum	$200	$330--370 **
Glass	--	$15--20
Newsprint	$5--15	$25--40
Cardboard	$0--5	$5--15

*Price is based on No. 2 dealer bundles from Iron Age Weekly.
**Price is based on "old sheet aluminum".
***Prices are delivered prices to respective markets.

Based on the potential material prices outlined in Table III-1, the estimated quantity and value of the resources recommended for recovery were determined for each ton of solid waste which is processed in the state. The potential revenue obtained from the sale of secondary materials is summarized in Table III-2.

Table III-2

SUMMARY OF POTENTIAL REVENUES FROM SECONDARY MATERIALS

Material	Percentage of Raw Waste	Material * Market Value (Dollars/Ton)	Value Per Ton of Processed Waste
Ferrous	7.9	$15 -- 27	$1.19--2.13
Aluminum	1.3	$200 --- 340	$2.60--4.42
Glass	5.7	$1 -- 3	$ .06--0.17
*Newsprint	2.5	0	0
*Cardboard	1.0	0	0
Total Potential Value	--	--	$3.85--6.72

*Anticipated freight rates have been deducted from potential market price.

An analysis of past prices of recoverable secondary materials has shown a dramatic change. In order to protect the seller, purchase agreements should be obtained in most instances. This addresses the problem of which type of purchase agreement is in the best interest of the owner of the resource recovery facility. From one point of view, it would be advantageous to have the buyer agree to a floor price or guaranteed selling price over the course of some years. While this might help immeasurably in projecting cash flows for the resource recovery facility, it also, in effect, forces the buyer to assume all risk in the marketplace, i. e., he must project what the selling price of these various materials might be over the duration of the purchase agreement. In most instances, this speculation and risk must be translated back into the selling price.

If, on the other hand, the seller assumes all risk, agreeing to sell the product on the basis of a published price for the product. Thus, the seller might reap the advantages of an upswing in the marketplace and suffer directly the effects of a low or soft spot in the market, such as we are experiencing today. On this basis, the seller could always exercise his option of stockpiling the material until the price picks up again or simply stop selling the material altogether until the market turns around.

There is no clear-cut firm answer or guideline which is always right, but the resource recovery plant owner should assess both sides before making a decision as to the type of purchase agreement most advantageous to him.

E. AFFECTS OF EXISTING OR PROPOSED LEGISLATION.

There are several factors attributable to the rise, fall and availability of recoverable secondary materials found in the state's solid waste stream. A potential factor is governmental activity which may have a direct bearing on the economic viability of the resource recovery project. Where proposed or existing legislation is regressive, the economic impact may be detrimental to the project. In other cases the availability of governmental support may impact favorably on the project. A few examples of proposed governmental activities in this area are discussed below:

The Energy and Resource Recovery Act of 1975, Senate Bill 946, proposed 316 million dollars of federal grant money to support resource recovery projects. The EPA would guarantee or make commitments to guarantee the construction financing of full-scale operational facilities for fuel, energy and materials recovery. This bill would also authorize operational and maintenance grants up to 25 percent of the construction cost of the resource recovery facilities, if the management of the facility can produce a plan for achieving financial self-sufficiency within a limited period of time under the proposal. The federal government would not subsidize resource recovery projects on a long-term basis and no guarantee could be undertaken after

September 1977. This bill would limit the outstanding indebtedness incurred by the guarantees to 500 million dollars.

The Senate Public Works Staff Committee is evaluating a comprehensive solid waste management proposal. This legislation would authorize federal funds to governmental entities for implementation programs consistent with state or area planning. This proposal would limit the a amount of the federal guarantee to two-thirds of the total project costs. The 500 million dollar limit for outstanding indebtedness suggested by this proposal also has a September 1977 time limit.

Senate Bill 613, the National Mandatory Deposit Lesislation, would prohibit the use of detachable openers on beverage cans within one year after enactment. The bill would also impose a five cent deposit on beverage containers within three years after enactment. Because the economic feasibility of resource recovery systems is partially dependent on the generation of revenue for reclaimed aluminum and ferrous waste, the enactment of this bill would change the economics of a resource recovery system.

Senate Bill 1474, the Materials and Energy Recovery Act of 1975, would increase the role of the EPA in all phases of energy and resource recovery projects. The new EPA role would be similar to the situation now existing for wastewater programs. The bill would establish a resource recovery research institute at a college or university in each of the ten EPA regions, provide for 80 percent federal funding for the establishment and administration of the programs and would implement state compliance schedules similar to the water quality programs.

APPENDIX A

ENERGY MARKETS INVESTIGATED

REGION ONE

	NAME	LOCATION
1.	Colstrip Power Plant	Colstrip
2.	MDU Power Plant	Miles City
3.	Holly Sugar Corporation	Sidney
4.	MDU Powerplant	Sidney

REGION TWO

	NAME	LOCATION
1.	Cut Bank Gas Co.	Cut Bank
2.	Fort Belknap Hospital	Fort Belknap
3.	Buttreys Foods	Great Falls
4.	College of Great Falls	Great Falls
5.	Columbus Hospital	Great Falls
6.	Con Agra Montana Inc.	Great Falls
7.	Deaconess Hospital	Great Falls
8.	Eddy's Bakeries	Great Falls
9.	General Mills Inc.	Great Falls
10.	Great Falls Packing Co.	Great Falls
11.	Great Falls Sewage Treatment Plant	Great Falls
12.	Malmstrom Air Force Base	Great Falls
13.	Phillips Petroleum Co.	Great Falls
14.	The Anaconda Company	Great Falls
15.	Burlington Northern	Havre
16.	Northern Montana College	Havre
17.	Big West Oil Company	Kevin

REGION THREE

	NAME	LOCATION
1.	Continental Oil Company	Billings
2.	Deaconess Hospital	Billings
3.	Eastern Montana College	Billings
4.	Exxon Company, U.S.A.	Billings
5.	Great Western Sugar Co.	Billings
6.	Rocky Mountain College	Billings
7.	Midland Packing Company	Billings
8.	Montana Power Company	Billings
9.	Montana Sulphur & Chemical Co.	Billings
10.	Pierce Packing Co.	Billings
11.	Roscoe Steel & Culvert Co.	Billings
12.	St. Vincents Hospital	Billings
13.	Farmers Union Central Exchange	Laurel
14.	United States Gypsum Co.	Lewistown

REGION FOUR

	NAME	LOCATION
1.	The Anaconda Co.	Anaconda
2.	Idaho Pole Co.	Bozeman
3.	Montana State University	Bozeman
4.	The Anaconda Co.	Butte
5.	Stauffer Chemical Co.	Butte
6.	Boulder River Training School	Boulder
7.	Chic./Mil./St. Paul R.R.	Deer Lodge
8.	Louisiana Pacific Corp.	Deer Lodge
9.	State Prison	Deer Lodge
10.	F. H. Stoltz Land & Lumber Co.	Dillion
11.	Pfizer, Inc.	Dillion
12.	Western Montana College	Dillion
13.	Asarco, Inc.	East Helena
14.	State T. B. Sanitarium	Galen
15.	Caird Engineering	Helena
16.	Clover Leaf-Jersey Dairy	Helena
17.	Fort Harrison	Helena
18.	Kaiser Cement & Gypsum Co.	Montana City
19.	Flint Valley Forest Products	Philipsburg
20.	Burlington Northern	Livingston
21.	Cyprus Industrial Mineral Co.	Three Forks
22.	Ideal Basic Industries	Trident
23.	Warm Springs State Institute	Warm Springs

REGION FIVE

	NAME	LOCATION
1.	U. S. Plywood Co.	Bonner
2.	Louisiana Pacific Corp.	Columbia Falls
3.	Plum Creek Lumber Co.	Columbia Falls
4.	The Anaconda Co.	Columbia Falls
5.	Waleswood Inc.	Darby
6.	S & W Sawmill	Darby
7.	C & C Plywood	Kalispell
8.	Equity Supply Co.	Kalispell
9.	Foh. Stoltz Land & Lumber Co.	Kalispell
10.	Kal-Mont Lumber Company	Kalispell
11.	St. Regis Co.	Libby
12.	W. R. Grace & Co.	Libby
13.	Borden Chemical	Missoula
14.	Evan's Products Co.	Missoula
15.	Hoerner Waldorf Corp.	Missoula
16.	University of Montana	Missoula
17.	Plum Creek Lumber Co.	Pablo
18.	Louisiana Pacific Corp.	Trout Creek

APPENDIX B

RESPONSES FROM POTENTIAL SECONDARY MATERIALS MARKETS

TEXT OF LETTER SENT TO POTENTIAL METALS MARKETS

Dear Sir:

Our firm has been retained by the State of Montana, Department of Environmental Sciences to conduct a solid waste management and resource recovery study for all solid wastes generated in the state. Included in the scope of work is the analysis of potential markets for secondary materials which may be recovered from the state's wastes.

A solid waste generation and composition study completed last fall indicated that approximately 5.9 percent of the total waste generated in the state is recoverable ferrous metals and 1.0 percent is recoverable nonferrous metals. From the composition study it was also determined that approximately three-fourths of recoverable nonferrous metals is aluminum. Based on the composition data, it is estimated that approximately 36,000 tons per year of ferrous metals, 4,500 tons per year of aluminum and 1,500 tons per year of other nonferrous metals will be disposed of in the state in 1975.

It is not possible, at the present time, to predict what percentage of the wastes generated in Montana can be processed and recovered economically. This information will be determined later in the study after processing and transportation costs and potential revenues of recoverable materials have been determined. It is, however, very unlikely that the results of the study will indicate that it is feasible to process in excess of 50 percent of the wastes generated in the state at the present time.

It would be most helpful to learn whether your company would be interested in purchasing these metals when and if they become available, and a general indication of their market value. Please understand that your response would not constitute a commitment to purchase these metals at this time; purchase agreements would be executed at a later date. We would appreciate the delicacy of requesting pricing data which would become public record, but all information you could provide would be helpful.

Since the refuse processing system has not been defined, we feel it is reasonable to assume that your chemical and physical specifications for the metals will be met. We would appreciate receiving any guidance on specifications or requirements you can provide so that we can assure that these can be included in the performance criteria of the resource recovery facility.

Due to the time schedule of the study, we would appreciate very much receiving as soon as possible a letter indicating your interest. If you have any questions, please feel free to call us at your earliest convenience.

Very truly yours,

HENNINGSON, DURHAM & RICHARDSON, INC. of MONTANA

Barry E. Damschen
Project Engineer

Vulcan Materials Company

METALS DIVISION / P. O. BOX 720 • SANDUSKY, OHIO 44870 • TELEPHONE 419 626-4610 • TWX 810-492-2638

January 16, 1976

Mr. Barry E. Damschen, Project Engineer
Henningson, Durham & Richardson, Inc. of Montana
2225 Eleventh Avenue
Helena, Montana 59601

Dear Barry:

I enjoyed meeting you in St. Paul and hope that we'll have an opportunity to meet again in the future. Your letter was waiting for me when I arrived back in the office.

As you know, we are currently purchasing ferrous metals which have been magnetically recovered from shredded municipal solid waste (MSW) in Great Falls, Montana. So there isn't any question that should ferrous metals be recovered from solid waste anywhere else in the state that we would expect to purchase them. There are two factors, however, which you should consider in your study and in preparing your later recommendations to the State. Due to the remoteness of Montana from the markets for ferrous metals from MSW it is absolutely essential that the resource recovery facility be close to rail loading facilities. A long truck haul prior to rail shipment would, in most cases, inflate costs to the point where revenue will be insufficient to justify recovery.

Just as importantly, the city or county contemplating recovery of ferrous metals should treat the revenue to be derived therefrom, as "found" money - not counted on as necessary to cover or defray operating costs or debt service. With the high freight costs, which are inescapable, low market prices for the ferrous scrap may require the facility to temporarily cease recovery or, at the least, stockpile against the time when prices return to normal. The impact of a drop in scrap revenue, when it is treated as a contribution to the general fund, is much less severe than of it is required to cover operating costs or debt service. The loss in revenue is real enough but the apparent impact is much less. It is the business of government to serve the public's refuse disposal requirements at the lowest possible cost to the public. When the sale of scrap is viewed as a cost-saving exercise rather than a means of generating revenue, the inevitable market fluctuations can more easily be accepted.

I've attached our specifications for both ferrous and nonferrous metals. I haven't said much about recovery of aluminum. While we would expect to purchase aluminum recovered from

MSW, we do not believe that there will be a sufficient quantity potentially recoverable from any installation in Montana to justify its recovery. That is a completely subjective evaluation at this point. Information developed at Ames, Iowa may change that evaluation.

I hope this information is of use to you. If I can be of further assistance, please let me know.

Sincerely,

VULCAN MATERIALS COMPANY
METALS DIVISION

Drew A Meyer

Drew A. Meyer
Business Manager - Municipal Metals

DAM:tdf

Att. (2)

Vulcan Materials Company

METALS DIVISION / P. O. BOX 720 • SANDUSKY, OHIO 44870 • TELEPHONE 419 626-4610 • TWX 810-492-2638

SPECIFICATION FOR LIGHT FERROUS SCRAP RECOVERED FROM MIXED MUNICIPAL WASTE

This specification applies to light ferrous scrap magnetically recovered from shredded, non-incinerated municipal waste. It is predominantly steel can scrap with some amount of miscellaneous ferrous materials; but specifically excludes shredded or unshredded heavy ferrous scrap such as appliances, castings, etc. The scrap is expected to be partially flattened and distorted due to prior shredding operations; however, the material is not to be wadded and balled to the extent that chemical detinning is infeasible.

The scrap should be substantially free of loose paper, plastic, rags, and other non-metallic inclusions. All loose contamination as well as dirt, organic matter and paint and lacquer coatings will be removed in the detinning process. All such processing losses will be deducted from the delivered weight of the scrap and only recoverable metal content will be paid for.

Vulcan Materials Company

METALS DIVISION / P. O. BOX 720 • SANDUSKY, OHIO 44870 • TELEPHONE 419 626-4610 • TWX 810-492-2638

SPECIFICATION FOR ALUMINUM SCRAP RECOVERED FROM MIXED MUNICIPAL WASTE

This scrap material shall be shredded and consist mainly of decorated or painted beverage cans as well as mixed alloy clippings and castings, foil and utensil aluminum. The material shall be free of iron, stainless steel, tin, lead, plastic and other foreign materials. Maximum allowable non-metallics such as dirt, grease, paint and paper is four per cent (4%). Contamination in excess of 4% shall be cause for rejection or a reduction in price based on lower metal recovery and additional preparation costs.

This scrap shall be shipped loose or in lightly-compressed bales. In no event should it be hydraulically compressed into dense bundles. Additionally, it shall be shipped in covered rail cars or truck trailers to prevent the material from becoming wet.

M&T™
CHEMICALS INC.
SUBSIDIARY OF AMERICAN CAN COMPANY

GENERAL OFFICES, RAHWAY, NEW JERSEY 07065

January 16, 1976

Mr. Barry E. Damschen
Project Engineer
Henningson, Durham & Richardson
2225 Eleventh Avenue
Helena, Montana 59601

Dear Mr. Damschen:

Thank you for your recent inquiry in which you advised us of the solid waste management and resource recovery study you are conducting for the State of Montana. M&T is actively engaged in the purchase of ferrous scrap recovered from solid waste processing facilities and would be very much interested in purchasing such material from the State of Montana.

The light gauge ferrous material, to be suitable for detinning,must be substantially free of extraneous matter, such as paper, plastics, fibers and other organic material with a minimum ferrous content of 95%. The ferrous material may contain steel and bimetal cans and other light gauge iron but must be free of heavy gauge iron and white goods. The scrap must be shredded but must not be balled or nuggetized and the scrap must not be incinerated.

M&T is prepared to enter into a long term agreement for the purchase of ferrous scrap. The pricing structure will be tied to the appropriate IRON AGE scrap market with a provision for a guaranteed return to the facility.

We look forward to working with you on this project and would like to express our appreciation for inviting M&T's participation.

Very truly yours,

J. J. Juhasz

J. J. Juhasz
Marketing Manager
Metals Recovery Division

JJJ:al

REYNOLDS ALUMINUM
REYNOLDS METALS COMPANY · RICHMOND, VIRGINIA 23261

January 22, 1976

Mr. Barry E. Damschen
Henningson, Durham & Richardson
2225 Eleventh Avenue
Helena, MT 59601

Dear Mr. Damschen:

Subject: State of Montana Solid Waste Management and Resource Recovery Study

We have received your letter of January 5, 1976 requesting an expression of interest in aluminum present in the State of Montana solid waste stream. From your letter, I understand that approximately 50 per cent of the estimated 4,500 tons per year of aluminum and 1,500 tons per year of other non-ferrous metals present in the refuse will be available for marketing.

Reynolds Metals Company is interested in resource recovery from municipal refuse and particularly in the aluminum recoverable from that refuse. In the last five years we have conducted extensive research programs pointed at recovering aluminum from municipal refuse, as well as recovering aluminum from auto shredder residues. This research effort, plus our knowledge of the various inputs to the municipal refuse stream, have assisted us in the development of specifications, copies of which are attached.

The Specification for Aluminum Recovered from Municipal Refuse is based, in part, on our research program test results on refuse samples (seen in the attached publications) and indicates that this specification is realistic and can be met.

Reynolds Can Stock Specification is included in the event you are able to recover a product consisting substantially of aluminum cans. Our submission of this specification does not imply that commercial equipment is available to recover aluminum that would meet this specification. However, advances in the state-of-the-art may at some time make this operation commercially feasible.

Reynolds Metals Company will certainly entertain serious discussions that could lead to a contractual arrangement for the long-term purchase of aluminum from municipal refuse at a time that is mutually agreeable to the State of Montana officials, or their contractors or agents, and Reynolds Metals Company officials.

We have negotiated contracts for the purchase of aluminum, which utilize as a part of the pricing base, a percentage of a published market price for a scrap aluminum category. This pricing base was satisfactory to the parties negotiating the contracts, which we feel would also be satisfactory to the State of Montana. Historically, commercial grades of scrap aluminum, similar to that recoverable from refuse, have moved in the \$.06 to \$.15/lb. range. Actual purchase prices for aluminum recovered from refuse would reflect the material condition and market position at the time of the sale.

I am enclosing copies of publications by Reynolds Metals Company personnel involved in the recovery of aluminum from various refuse streams. I believe you will find them most informative and will perhaps help you to move towards the point at which discussions regarding the marketing of recovered aluminum can begin between the interested parties.

If we can provide any additional information on aluminum recovery from municipal refuse, please contact us.

Sincerely,

REYNOLDS METALS COMPANY

G. F. Bourcier
Gilbert F. Bourcier, Manager
Resource Recovery Programs

GFB:cwh

Enclosures

cc: R. F. Testin
S. T. Abbate
J. R. Amos
D. B. Rider

REYNOLDS' SPECIFICATION FOR CAN STOCK

RECOVERED FROM MUNICIPAL REFUSE

The scrap aluminum in mixed municipal refuse must be separated from all other materials. If the material is reclaimed using dry processing following thermal treatment of the refuse, it must be baled to a minimum density of 30 pounds per cubic foot. If the aluminum is separated from raw refuse or if wet processing techniques are used to separate the aluminum, the aluminum must be shredded or dried prior to baling. The shredded material must pass over a U. S. Standard 12 mesh screen to reduce fines (dust, dirt, sand, paint, etc.). Fines must not exceed three per cent (3%) of gross weight. The finished product must be baled to a minimum density of 30 lbs./ft.^{3} Alternatively, dry shredded material may be shipped loose if it has a density of 15-25 lbs./ft^3. Analyses will be on the melt of a total shipment.

Each shipment shall yield after melting a total net weight of at least 85 per cent (85%) of the gross weight of aluminum scrap received and shall contain by chemical analysis the following maximum elements.

ELEMENT	MAXIMUM WEIGHT PER CENT
Si	.30
Fe	.70
Cu	.25
Mn	1.25
Mg	2.0
Cr	.10
Ni	.05
Zn	.25
Ti	.05
Bi	.02
Pb	.02
Sn	.02
Others - Each	.04
Others - Total	.12
Al	remainder

Revised January 1976
Reynolds Metals Company

This specification is subject to change without notice and should not be reproduced or distributed without the prior written approval of Reynolds Metals Company.

SPECIFICATIONS FOR ALUMINUM RECOVERED FROM MIXED MUNICIPAL REFUSE

The scrap aluminum in mixed municipal refuse must be separated from all other materials. If the material is reclaimed using dry processing following thermal treatment of the refuse, it must be baled to a minimum density of 30 pounds per cubic foot. If the aluminum is separated from raw refuse or if wet processing techniques are used to separate the aluminum, the aluminum must be shredded or dried prior to baling. The shredded material must pass over a U. S. Standard 12 mesh screen to reduce fines (dust, dirt, sand, paint, etc.). Fines must not exceed three per cent (3%) of gross weight. The finished product must be baled to a minimum density of 30 lbs./ft.^{3} Alternatively, dry shredded material may be shipped loose if it has a density of 15-25 lbs./ft^3. Analyses will be on the melt of a total shipment.

Each shipment shall yield after melting a total net weight of at least 85 per cent (85%) of the gross weight of aluminum scrap received and shall contain by chemical analysis the following maximum elements.

ELEMENT	MAXIMUM WEIGHT PER CENT
Si	0.5
Fe	1.0
Cu	1.0
Mn	1.25
Mg	2.0
Cr	0.3
Ni	0.3
Zn	1.0
Bi	0.3
Pb	0.3
Sn	0.3
Others*	0.15
Al	remainder

---

*Less than 0.05 each

Revised January 1976
Reynolds Metals Company

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SPECIFICATION FOR PROCESSED ALL-ALUMINUM CANS

(This specification applies to all-aluminum cans which, by definition, includes other clean can or foil-type aluminum scrap from the kitchen; such as, dinner trays, pot pie pans, snack packs, etc.)

Aluminum cans must be separated from all other material.

All-aluminum cans must then be shredded to a 15 - 25 lbs. cubic foot density. All scrap is to be magnetically separated and free from iron contamination and the iron not included in shipment. Final product not to contain more than 3% fines over a U. S. Standard 12 Mesh Screen. Fines are described as aluminum, dust, dirt, sand, paint, etc. All fines from the screening operation not to be shipped. Material must be shipped in a dry condition.

Shredded scrap must be shipped in bulk form without boxes or other containers in boxcars with a minimum of 9 ft. wide doors. Bulkheads will be installed to either side of the doorway to prevent the shredded scrap from spilling into the doorway and leaving the space between the doors open. Boxcars must be loaded to a minimum of 60,000 lbs. to assure lowest freight rate. Freight costs in excess of the 60,000 lb. minimum rate will be at the shipper's expense. At the shipper's option, the total car may be loaded if grain doors are added across both 9 ft. minimum unloading doors. If this loading system is used, internal bulkheading may be omitted. All cars should be light weighed prior to loading with the certified tare weight shown on the waybill. Waybill should also show that the car is to be weighed en route for gross weight. Proper deductions will be made for tare and dunnage weights to determine actual net metal weight shipped.

A copy of a shipping tally and/or packing list is to be attached to the inside of each car (truck) as close to the doorway as possible. This document should contain the shipping points, destination, order number, date of shipment, car or truck-trailer number, routing, and certified light weight.

All scrap is subject to final inspection, weighing and acceptance at Reynolds' designated receiving plant. Material not meeting the above specification will be subject to adjustments or rejection and returned with freight and demurrage charges to shipper's account.

Revised January, 1976
Reynolds Metals Company

This specification is subject to change without notice and should not be reproduced or distributed without the prior written approval of Reynolds Metals Company.

ALUMINUM COMPANY OF AMERICA

ALCOA BUILDING · PITTSBURGH, PENNSYLVANIA 15219

ALCOA

January 12, 1976

Mr. Barry E. Damschen, Project Engineer
Henningson, Durham & Richardson, Inc.
2225 Eleventh Avenue
Helena, Montana 59601

Dear Mr. Damschen:

I am in receipt of your letter dated January 5, 1976, in which you request specifications and pricing based on today's dollar value with a correction factor for future delivery. Therefore, I am sending to you Alcoa's specifications regarding Grade I and Grade II. In addition, I will include our present pricing formula. With regard to a pricing formula, I would like to point out that such would be applicable relative to today's market. In other words, should the market or Alcoa's need change in the future, the pricing formula could well change accordingly. The price can range from $200 to $400 per ton, based on today's market conditions, depending upon the quality of the material. You will please note that we have not only a base price, but also a minimum price for both Grades I and II.

We have attempted to value aluminum scrap extracted from solid waste relative to the value of 99.5 aluminum ingot as quoted by Alcoa. The escalation and de-escalation features again are an attempt to evaluate scrap when compared with primary metal which in effect is an attempt to protect the seller as well as the buyer.

It is my understanding that this facility will service the State of Montana which would yield an average of 4.5 million pounds of aluminum per year. Please inform us of the estimated start-up date of this facility.

We would ask that you do not treat this letter as a formal proposal. If you wish to receive a formal purchase agreement, I would like to send you one covering the numerous areas which must be covered in arriving at a long-term (five years) relationship with our companies. In the drawing up of a possible formal contract for the purchase by Alcoa of the aluminum fraction, we at Alcoa would like to strongly urge that such a formal definitive contract be inagurated within 60 days upon receipt by you of the proposed formal contract.

Since Alcoa has been rather open in discussing specifications and pricing formula, would you please treat this information as confidential, keeping it within the confines of your own company. Should there be anything further that you require in this regard, please do not hesitate to contact me.

Cordially,

WR Malby

WALTER R. MALBY, Manager
Municipal Reclamation Programs
sjl

Reclamation Division

Attachment

SALVAGE DIVISION
CARL WEISSMAN & SONS
INCORPORATED

TELEPHONE 453-0301
AREA CODE 406

P. O. BOX 1204
300 THIRD AVENUE SOUTH
GREAT FALLS, MONTANA 59403

January 16, 1976

Henningson, Durham & Richardson
2225 Eleventh Avenue
Helena, Montana 59601

Attn: Barry E. Damschen
Project Engineer

Dear Sir:

In response to your letter of January 6, and as a result of your personal visit with the writer on January 13, I direct this response to you.

First of all, let us go on record that our company would be interested in purchasing marketable non-ferrous metals if and when they become available. In connection with their value at the present time I am enclosing a xerox copy relating to the markets as of the date indicated. Please understand, however, that there is a fluctuating market and this market is daily recorded throughout several of the trade periodicals, all of which are dependable. It is hoped that this will aid you.

In response to your study of the recovery of recyclable metals, it had better be advised that private industry has in the past, not only in Montana but elsewhere, existed and a lively-hood derived therefrom. We are not in any mood or inclination to see this industry usurped by governmental controlled or owned or involvement through its operations. It is understanding that processing problems often significantly are very much different in private industry than when publicly owned and operated and the profit motive too is of a different value. It is often found, when publicly or politically operated, that these people fail to understand or resist the economic issues inherent in transforming waste into recoverable and marketable raw materials. Therefore it is very much to the important side of this issue that in the final analysis that it be handled properly. Fortunately there have been sufficient experiences now with ill conceived programs that more and more state and municipalities are becoming concerned with the economic problems that inhibit our industry's ability to recover more of the waste which presently lacks markets or defies economic handling. For instance we have had good experience thus far with the State of California, which has constructed a program in cooperation with private industry---not in competition or with or defiance of it.

SALVAGE DIVISION
CARL WEISSMAN & SONS
INCORPORATED

TELEPHONE 453-0301
AREA CODE 406

P. O. BOX 1204
300 THIRD AVENUE SOUTH
GREAT FALLS, MONTANA 59403

Henningson, Durham & Richardson
Helena, Montana
January 16, 1976
Page 2

I am sure that the Henningson, Durham and Richardson group are very much concerned with conditions which would enable more metals to be marketed and despite cyclical nature of their value be attended to. Therefore I am enclosing a copy of the metal specification for which our industry follows and in addition I would be most happy to provide as much information as I can relative to the problems and costs involved in recovering, processing, and marketing the material. I also strongly recommend that you can and will receive utmost consideration and aid if you will be in touch with the national office of our recycling industries association which is located as follows: National Association of Recycling Industries Incorporated, 330 Madison Avenue, New York, New York 10017, Attn: M. J. Mighdoll, Executive Vice President. We have been in touch with this organization relative to your involvement in Montana and they have assured us that they would be most happy to assist in regard to some of the broader marketing issues, including the transportation, tax and other policies that limit market opportunities for recycled materials.

I wish to, at this point, thank you for your decision to contact this writer and hopefully we may be able to be of considerable aid reciprocally.

Very truly yours,

CARL WEISSMAN & SONS, INC.

M Weissman
Maurice Weissman
Vice President

MW/nm
Enc: 2

CARL WEISSMAN & SONS, INC.
P. O. BOX 1204
GREAT FALLS, MONTANA 59403

National Association of Recycling Industries, Inc.

Standard Classification for Nonferrous Scrap Metals

CIRCULAR NF-73

Official Copies of this Classification always carry the Association's Seal

EFFECTIVE AS OF APRIL 1, 1973

Issued from
ASSOCIATION HEADQUARTERS
330 Madison Avenue, New York, N. Y. 10017

CODE WORD ITEM

Apple 1.—DELIVERY

a. Delivery of more or less on the specified quantity up to 1¼ per cent is permissible.

b. If the term "about" is used, it is understood that 5 per cent more or less of the quantity may be delivered.

c. Should the seller fail to make deliveries as specified in the contract the purchaser has the option of cancelling all of the uncompleted deliveries or holding the seller for whatever damages the purchaser may sustain through failure to deliver and if unable to agree on the amount of damages, an Arbitration Committee of the National Association of Secondary Material Industries, Inc. may be appointed for this purpose, to determine the amount of such damages.

d. In the event that buyer should claim the goods, delivered on a contract, are not up to the proper standard, and the seller claims that they are a proper delivery, the dispute may be referred to an Arbitration Committee of the National Association of Secondary Material Industries, Inc. to be appointed for that purpose.

e. A carload, unless otherwise designated, shall consist of the weight governing the minimum carload weight at the lowest carload rate of freight in the territory in which the seller is located. If destination of material requires a greater carload minimum weight, buyer must so specify.

f. A ton shall be understood to be 2,000 pounds unless otherwise specified. On material purchased for export shipment a ton shall be specified as either a Gross Ton of 2240 lbs., or a Metric Ton of 2204.6 lbs.

g. If, through embargo, a delivery cannot be made at the time specified, the contract shall remain valid, and shall be completed immediately on the lifting of the embargo, and terms of said contract shall not be changed. When shipments for export for which space has been engaged have been delivered or tendered to a steamship for forwarding and through inadequacy of cargo space the steamship cannot accept the shipment, or where steamer is delayed in sailing beyond its scheduled time, shipment on the next steamer from the port of shipment shall be deemed a compliance with the contract as to time of shipment.

h. In case of a difference in weight and the seller is not willing to accept buyer's weights, a sworn public weigher shall be employed and the party most in error must pay the costs of handling and reweighing.

i. When material is such that it can be sorted by hand, consignees cannot reject the entire shipment if the percentage of rejection does not exceed 10 per cent. The disposition of the rejected material should then be arranged by negotiations; no replacement of the rejected material to be made.

Upon request of the shipper, rejections shall be returnable to the seller on domestic shipments within 10 days and on foreign shipments within 30 days from the time notice of rejection is received by them and provided government regulations permit such return. Seller to pay 1¢ per lb. on material rejected to cover cost of sorting and packing and seller to be responsible for freight both ways.

j. PACKAGES

Shall be good strong packages suitable for shipment and each package shall be plainly marked with separate shipping marks and numbers and with the gross and tare weights so that the packages may reach their destination and their weights can be easily checked.

Berry 2.—No. 1 COPPER WIRE

Shall consist of clean, untinned, uncoated, unalloyed copper wire and cable, not smaller than No. 16 B & S wire gauge, free of burnt wire which is brittle. Hydraulically briquetted copper subject to agreement.

Birch 3.—No. 2 COPPER WIRE

Shall consist of miscellaneous, unalloyed copper wire having a nominal 96% copper content (minimum 94%) as determined by electrolytic assay. Should be free of the following: Excessively leaded, tinned, soldered copper wire; brass and bronze wire; excessive oil content, iron, and non-metallics; copper wire from burning, containing insulation; hair wire; burnt wire which is brittle; and should be reasonably free of ash. Hydraulically briquetted copper wire subject to agreement.

CODE WORD ITEM

Candy 4.—No. 1 HEAVY COPPER

Shall consist of clean, unalloyed, uncoated copper clippings, punchings, bus bars, commutator segments, and wire not less than $\frac{1}{16}$ of an inch thick, free of burnt wire which is brittle; but may include clean copper tubing. Hydraulically briquetted copper subject to agreemnet.

Cliff 5.—No. 2 COPPER

Shall consist of miscellaneous, unalloyed copper scrap having a nominal 96% copper content (minimum 94%) as determined by electrolytic assay. Should be free of the following: Excessively leaded, tinned, soldered copper scrap; brasses and bronzes; excessive oil content, iron and non-metallics; copper tubing with other than copper connections or with sediment; copper wire from burning, containing insulation; hair wire; burnt wire which is brittle; and should be reasonably free of ash. Hydraulically briquetted copper subject to agreement.

Dream 6.—LIGHT COPPER

Shall consist of miscellaneous, unalloyed copper scrap having a nominal 92% copper content (minimum 88%) as determined by electrolytic assay and shall consist of sheet copper, gutters, downspouts, kettles, boilers, and similar scrap. Should be free of the following: Burnt hair wire; copper clad; plating racks; grindings; copper wire from burning, containing insulation; radiators; fire extinguishers; refrigerator units; electrotype shells; screening; excessively leaded, tinned, soldered scrap; brasses and bronzes; excessive oil, iron and non-metallics; and should be reasonably free of ash. Hydraulically briquetted copper subject to agreement. Any items excluded in this grade are also excluded in the higher grades above.

Drink 7.—REFINERY BRASS

Shall contain a minimum of 61.3% copper and maximum 5% iron and to consist of brass and bronze solids and turnings, and alloyed and contaminated copper scrap. Shall be free of insulated wire, grindings, electrotype shells and non-metallics. Hydraulically briquetted material subject to agreement.

Drove 8.—COPPER-BEARING SCRAP

Shall consist of miscellaneous copper-containing skimmings, grindings, ashes, irony brass and copper, residues and slags. Free of insulated wires; copper chlorides; unprepared tangled material; large motors; pyrophoric material; asbestos brake linings; furnace bottoms; high lead materials; graphite crucibles; and noxious and explosive materials. Fine powdered material by agreement. Hydraulically briquetted material subject to agreement.

Ebony 9.—COMPOSITION OR RED BRASS

Shall consist of red brass scrap, valves, machinery bearings and other machinery parts, including miscellaneous castings made of copper, tin, zinc, and/or lead. Should be free of semi-red brass castings (78% to 81% copper); railroad car boxes and other similar high-lead alloys; cocks and faucets; gates; pot pieces; ingots and burned brass; aluminum and manganese bronzes; iron and non-metallics. No piece to measure more than 12" over any one part or weigh over 100 lbs.

Enerv 10.—RED BRASS COMPOSITION TURNINGS

Shall consist of turnings from red brass composition material and should be sold subject to sample or analysis.

Eider 11.—GENUINE BABBITT-LINED BRASS BUSHINGS

Shall consist of red brass bushings and bearings from automobiles and other machinery, shall contain not less than 12% high tin base babbitt, and shall be free of iron-backed bearings.

Eland 12.—HIGH GRADE — LOW LEAD BRONZE SOLIDS

It is recommended these materials be sold by analysis.

Elbow 13.—BRONZE PAPER MILL WIRE CLOTH

Shall consist of clean genuine Fourdrinier wire cloth and screen having a minimum copper content of 87%, minimum tin content of 3%, and a maximum lead content of 1%, free of stainless steel and Monel metal stranding.

Elias 14.—HIGH LEAD BRONZE SOLIDS AND BORINGS

It is recommended that these materials be sold on sample or analysis.

CODE WORD ITEM

Engel 15.—MACHINERY OR HARD BRASS SOLIDS

Shall have a copper content of not less than 75%, a tin content of not less than 6%, and a lead content of not less than 6%—nor more than 11%, and total impurities, exclusive of zinc, antimony, and nickel of not more than 0.75%; the antimony content not to exceed 0.50%. Shall be free of lined and unlined standard red carboxes.

Erin 16.—MACHINERY OR HARD BRASS BORINGS

Shall have a copper content of not less than 75%, a tin content of not less than 6%, and a lead content of not less than 6%—nor more than 11%, and the total impurities, exclusive of zinc, antimony, and nickel of not more than 0.75%; the antimony content not to exceed 0.50%.

Fence 17.—UNLINED STANDARD RED CAR BOXES (CLEAN JOURNALS)

Shall consist of standard unlined and/or sweated railroad boxes and unlined and/or sweated car journal bearings, free of yellow boxes and iron-backed boxes.

Ferry 18.—LINED STANDARD RED CAR BOXES (LINED JOURNALS)

Shall consist of standard babbitt-lined railroad boxes and/or babbitt-lined car journal bearings, free of yellow boxes and iron-backed boxes.

Grape 19.—COCKS AND FAUCETS

Shall consist of mixed clean red and yellow brass, including chrome or nickel-plated, free of gas cocks, beer faucets, and aluminum and zinc base die cast material, and to contain a minimum of 35% semi-red.

Greet 20.—MIXED BRASS SCREENS

To consist of clean mixed-copper, brass and bronze screens, and to be free of excessively dirty and painted material.

Honey 21.—YELLOW BRASS SCRAP

Shall consist of brass castings, rolled brass, rod brass, tubing and miscellaneous yellow brasses, including plated brass. Must be free of manganese-bronze, aluminum-bronze, unsweated radiators or radiator parts, iron, excessively dirty and corroded materials.

Ivory 22.—YELLOW BRASS CASTINGS

Shall consist of yellow brass castings in crucible shape, no piece to measure more than 12 inches over any one part; and shall be free of brass forgings, silicon bronze, aluminum bronze and manganese bronze, and not to contain more than 15% nickel plated material.

Knife 23.—OLD ROLLED BRASS

Shall consist of old pieces of yellow sheet brass and yellow light tubing brass, free from solder, tinned and nickel plated material, iron, paint and corrosion, rod brass and condenser tubes.

Label 24.—NEW BRASS CLIPPINGS

Shall consist of the cuttings of new unleaded yellow brass sheet or plate, to be clean and free from foreign substances and not to contain more than 10% of clean brass punchings under ¼". To be free of Muntz metal and naval brass.

Lace 25.—BRASS SHELL CASES WITHOUT PRIMERS

Shall consist of clean fired 70/30 brass shell cases free of primers and any other foreign material.

Lady 26.—BRASS SHELL CASES WITH PRIMERS

Shall consist of clean fired 70/30 brass shell cases containing the brass primers and which contain no other foreign material.

Lake 27.—BRASS SMALL ARMS AND RIFLE SHELLS, CLEAN FIRED

Shall consist of clean fired 70/30 brass shells free of bullets, iron and any other foreign material.

Lamb 28.—BRASS SMALL ARMS AND RIFLE SHELLS, CLEAN MUFFLED (POPPED)

Shall consist of clean muffled (popped) 70/30 brass shells free of bullets, iron and any other foreign material.

Lark 29.—YELLOW BRASS PRIMER

Shall consist of clean yellow brass primers, burnt or unburnt. Free of iron, excessive dirt, corrosion and any other foreign material.

CODE WORD ITEM

Maize 30.—MIXED NEW NICKEL SILVER CLIPPINGS

Shall consist of one or more nickel silver alloys and the range of nickel content to be specified, free of chrome or any other plating material. Leaded nickel silver clippings should be packed and sold separately. Not to contain more than 10% of clean punchings under ¼ inch.

Major 31.—NEW NICKEL SILVER CLIPPINGS AND SOLIDS

Shall consist of new, clean nickel silver clippings, plate, rod and forgings, and other rolled shapes, free of chrome or any other plating material. Must be sold on nickel content specifications such as 10% — 12% — 15% — 18% — 20%. Leaded nickel silver clippings should be packed and sold separately. A description as to its physical characteristics should be made in offering all nickel silver material.

Malar 32.—NEW SEGREGATED NICKEL SILVER CLIPPINGS

Shall consist of one specified nickel silver alloy. Not to contain more than 10% of clean punchings under ¼ inch.

Malic 33.—OLD NICKEL SILVER

Shall consist of Old Nickel Silver Sheet, Pipe, Rod, Tubes, Wire, Screen, soldered or unsoldered. Must not be trimmed seams alone and it is also to be free of foreign substances, iron rimmed material or other metals.

Melon 34.—BRASS PIPE

Shall consist of brass pipe free of plated and soldered materials or pipes with cast brass connections. To be sound, clean pipes free of sediment and condenser tubes.

Naggy 35.—NICKEL SILVER CASTINGS

To be packed and sold separately.

Niece 36.—NICKEL SILVER TURNINGS

To be sold by sample or analysis.

Night 37.—YELLOW BRASS ROD TURNINGS

Shall consist of strictly rod turnings, free of aluminum, manganese, composition, Tobin and Muntz metal turnings; not to contain over 3% free iron, oil or other moisture; to be free of grindings and babbitts; to contain not more than 0.30% tin and not more than 0.15% alloyed iron.

Noble 38.—NEW YELLOW BRASS ROD ENDS

Shall consist of new, clean rod ends from free turning brass rods or forging rods, not to contain more than 0.30% tin and not more than 0.15% alloyed iron. To be free of Muntz metal and naval brass or any other alloys. To be in pieces not larger than 12" and free of foreign matter.

Nomad 39.—YELLOW BRASS TURNINGS

Shall consist of yellow brass turnings, free of aluminum, manganese and composition turnings; not to contain over 3% of free iron, oil or other moisture; to be free of grindings and babbitts. To avoid dispute, to be sold subject to sample or analysis.

Ocean 40.—MIXED UNSWEATED AUTO RADIATORS

Shall consist of mixed automobile radiators, to be free of aluminum radiators, and iron finned radiators. All radiators to be subject to deduction of actual iron. The tonnage specification should cover the gross weight of the radiators, unless otherwise specified.

Pales 41.—ADMIRALTY BRASS CONDENSER TUBES

Shall consist of clean sound Admiralty condenser tubing which may be plated or unplated, free of nickel alloy, aluminum alloy, and corroded material.

Pallu 42.—ALUMINUM BRASS CONDENSER TUBES

Shall consist of clean sound condenser tubing which may be plated or unplated, free of nickel alloy, and corroded material.

Palms 43.—MUNTZ METAL TUBES

Shall consist of clean sound Muntz metal tubing which may be plated or unplated, free of nickel alloy, aluminum alloy, and corroded material.

Pants 44.—PLATED ROLLED BRASS

Shall consist of plated brass sheet, pipe, tubing, and reflectors, free of soldered, tinned, corroded, and aluminum-painted material, Muntz metal and Admiralty tubing, and material with cast brass connections.

Code Word Item

Parch 45.—MANGANESE BRONZE SOLIDS

Shall have a copper content of not less than 55%, a lead content of not more than 1%, and shall be free of Aluminum bronze and Silicon bronze.

Racks 46.—SCRAP LEAD — SOFT

Shall consist of clean soft scrap lead, free of all foreign materials such as drosses, battery lead, lead covered cable, hard lead, collapsible tubes, foil, type metals, zinc, iron and brass fittings, dirty chemical lead. Free of radioactive materials.

Radio 47.—MIXED HARD/SOFT SCRAP LEAD

Shall consist of clean lead solids, free of foreign materials, such as drosses, battery lead, lead covered cable, collapsible tubes, type metals, zinc, iron and brass fittings, dirty chemical lead. Free of radioactive materials.

Rails 48.—BATTERY PLATES

If cells (plates, separators, and lugs) or battery plates, must be reasonably free of rubber. May be bought and sold by assay or as agreed between buyer and seller.

Rains 49.—DRAINED WHOLE BATTERIES

Batteries to be free of liquid and extraneous material content. Aircraft (aluminum or steel cased) and other special batteries subject to special agreement.

Rakes 50.—BATTERY LUGS

Shall be free from battery plates, rubber and foreign material. A minimum of 97% metallic content is required.

Ranks 51.—PEWTER

Shall consist of tableware and soda-fountain boxes but should contain a minimum of 84% tin. Siphon tops to be accounted for separately. Material must be free of brass, zinc, and other foreign metals.

Ranch 52.—BLOCK TIN

Block Tin must assay minimum of 98% tin, and to be free of liquids, solder, and brass connections, pewter, pumps, pot pieces, dirt.

Raves 53.—HIGH TIN BASE BABBITT

Shall contain a minimum of 78% tin and be free of brassy or zincy metals.

Relay 54.—LEAD COVERED COPPER CABLE

Free of armored covered cable, and foreign material.

Rents 55.—LEAD DROSS

Should be clean and reasonably free of foreign matter, iron, dirt, harmful chemicals or other metals. Free of radioactive materials. Assay basis, or as agreed between buyer and seller. Other metals present such as antimony, tin, etc. to be accounted for as agreed between buyer and seller.

Ropes 56.—LEAD WEIGHTS

May consist of lead balances with or without iron, as may be specified. Free of foreign materials.

Roses 57.—MIXED COMMON BABBITT

Shall consist of lead base bearing metal containing not less than 8% tin, free from Allens Metal, Ornamental, Antimonial and Type Metal. Must be free from all zincy and excessive copper in the alloy.

Saves 58.—OLD ZINC DIE CAST SCRAP

Shall consist of miscellaneous old zinc base die castings, with or without iron and other foreign attachments. Must be free of borings, turnings, dross pieces, chunks, melted pieces and skimmings. All unmeltables, dirt, foreign attachments, and volatile substances (such as rubber, cork, plastic, grease, etc.) are deductible. Material containing in excess of 30% iron will not constitute good delivery.

Scabs 59.—NEW ZINC DIE CAST SCRAP

Shall consist of new or unused, clean, zinc base die castings. Castings to be unplated, unpainted, and free from corrosion.

Scope 60.—NEW PLATED ZINC DIE CAST SCRAP

Shall consist of new or unused clean, plated zinc base die castings, free from corrosion.

Code Word Item

Scoot 61.—ZINC DIE CAST AUTOMOTIVE GRILLES

Shall consist of clean, old or used zinc base die cast automotive grilles, free from soldered material. All foreign attachments and extraneous material are deductible.

Score 62.—OLD SCRAP ZINC

Shall consist of clean dry scrap zinc, such as sheets, jar lids, clean unalloyed castings and anti-corrosion plates. Borings and turnings are not acceptable. Material must not be excessively corroded or oxidized. All foreign attachments and extraneous materials are deductible.

Screen 63.—NEW ZINC CLIPPINGS

Shall consist of any new pure zinc sheets or stampings free from corrosion. To contain no foreign material or attachments. Printers zinc, such as engravers zinc, lithograph sheets and addressograph plates subject to special arrangements. Printers zinc to be free of routings.

Scull 64.—ZINC DIE CAST SLABS OR PIGS

Shall consist of melted zinc base die cast materials, in smooth clean solid slabs or pigs. Material to be free from drosses and to contain a minimum zinc content of 90%. To contain a maximum of 0.1% nickel and maximum of 1% lead. Blocks are acceptable upon mutual agreement.

Scribe 65.—CRUSHED CLEAN SORTED FRAGMENTIZERS DIE CAST SCRAP. AS PRODUCED FROM AUTOMOBILE FRAGMENTIZERS.

To be clean, free of dirt, oil, glass, rubber, and trash.
To contain a maximum of 5% unmeltables such as free iron, copper, aluminum and other metals.

Scroll 66.—UNSORTED FRAGMENTIZERS DIE CAST SCRAP.

Material to contain 65% zinc-bearing scrap. Trash, dirt, glass, rubber, oil, iron and other unmeltables not to exceed 5%. Quality to be determined by mutual agreement between buyer and seller.

Scrub 67.—HOT DIP GALVANIZERS SLAB ZINC DROSS (Batch Process)

Shall consist only of galvanizers unsweated zinc dross in slab form from hot dip galvanizing (Batch Process) with a minimum zinc content of 92% and shall be free of skimmings and tramp iron. Broken pieces under 2" in diameter shall not exceed 10% of the weight of each shipment. Slabs shall not weigh over 100 pounds each. Material from continuous galvanizing operation is not acceptable. Blocks are acceptable upon mutual agreement.

Seal 63.—CONTINUOUS LINE GALVANIZING SLAB ZINC TOP DROSS.

Shall consist of unsweated zinc dross removed from the top of a continuous line galvanizing bath, in slab form not weighing in excess of 100 pounds each, with a minimum zinc content of 90%. Shall be free of skimmings. Broken pieces under 2" in diameter shall not exceed 10% of the weight of each shipment.

Seam 69.—CONTINUOUS LINE GALVANIZING SLAB ZINC BOTTOM DROSS

Shall consist of unsweated zinc dross removed from the bottom of a continuous line galvanizing bath, in slab form not weighing in excess of 100 pounds each, with a minimum zinc content of 92%. Shall be free of skimmings. Broken pieces under 2" in diameter shall not exceed 10% of the weight of each shipment.

Shelf 70.—PRIME ZINC DIE CAST DROSS

Shall consist of metal skimmed from the top of pot of molten zinc die cast metal. Must be unsweated, unfluxed, shiny, smooth, metallic and free from corrosion or oxidation. Should be poured in molds or in small mounds weighing not over 75 pounds each. Zinc shall be minimum of 85%.

ANY OTHER GRADES OF ZINC-BEARING MATERIALS NOT MENTIONED ARE SUBJECT TO SPECIAL ARRANGEMENT.

Table 71.—NEW PURE ALUMINUM CLIPPINGS

Shall consist of new, clean, unalloyed sheet, clippings and/or aluminum sheet cuttings, free from oil and grease, foil and any other foreign substances and from punchings less than ½" in size.

Code Word Item

Taboo **72.—MIXED LOW COPPER ALUMINUM CLIPPINGS AND SOLIDS**

Shall consist of new, clean, uncoated and unpainted low copper aluminum scrap of two or more alloys and to be free of foil, hair wire, wire screen, dirt, and other foreign substances. Grease and oil not to total more than 1%. Also free from punchings less than ½" in size. New can stock subject to arrangement between buyer and seller.

Tabor **73.—MIXED OLD ALLOY SHEET ALUMINUM**

Shall consist of clean old alloy sheet aluminum of two or more alloys and to be free of 70S series, foil, venetian blinds, castings, hair wire, screen wire, food or beverage containers, pie plates, dirt, and other foreign substances. Oil and grease not to total more than 1%. Up to 10% painted sidings and awnings permitted.

Taint **74.—SCRAP SHEET AND SHEET UTENSIL ALUMINUM**

Shall consist of clean, unpainted old 2S or 3S aluminum sheet and sheet utensils, free from hub caps, radiator shells, airplane sheet, foil, food or beverage containers, pie plates, oil cans and bottle caps, dirt, and other foreign substances. Oil and grease not to total more than 1%.

Take **75.—NEW ALUMINUM CAN STOCK**

Shall consist of new low copper aluminum can stock and clippings, clean, lithographed or not lithographed, and coated with clear lacquer but free of lids with sealers, iron, dirt and other foreign contamination. Oil not to exceed 1%.

Talc **76.—OLD CAN STOCK**

Shall consist of clean old aluminum cans, decorated or clear, free of iron, dirt, liquid and/or other foreign contamination.

Tale **77.—PAINTED SIDING**

Shall consist of clean, low copper aluminum siding scrap, painted one or two sides, free of iron, dirt, corrosion, fiber backing or other types of foreign contamination.

Talent **78.—COATED SCRAP**

Shall consist of awnings, venetian blinds, vinyl, plastic, etc. Shall be sbject to special arrangements between buyers and sellers.

Talk **79.—ALUMINUM COPPER RADIATORS**

Shall consist of clean aluminum and copper radiators, and/or aluminum fins on copper tubing, free of brass tubing, iron and other foreign contamination.

Tall **80.—E. C. ALUMINUM NODULES**

Shall consist of clean E. C. aluminum, chopped or shredded, free of screening, hair-wire, iron, insulation, copper and other foreign contamination. Must be free of minus 20 mesh material. Must contain 99.45% aluminum content.

Talon **81.—NEW PURE ALUMINUM WIRE AND CABLE**

Shall consist of new, clean, unalloyed aluminum wire or cable free from hair wire, wire screen, iron, insulation and any other foreign substance.

Taste **82.—OLD PURE ALUMINUM WIRE AND CABLE**

Shall consist of old, unalloyed aluminum wire or cable containing not over 1% free oxide or dirt and free from hair wire, wire screen, iron, insulation and any other foreign substance.

Tarry **83.—ALUMINUM PISTONS**

(a) Clean Aluminum Pistons

Shall consist of clean aluminum pistons to be free from struts, bushings, shafts, iron rings and any other foreign materials. Oil and grease not to exceed 2%.

(b) Aluminum Pistons with Struts

Shall consist of clean whole aluminum pistons with struts to be free from bushings, shafts, iron rings and any other foreign materials. Oil and grease not to exceed 2%.

(c) Irony Aluminum Pistons

Should be sold on recovery basis, or by special arrangements with purchaser.

Code Word Item

Teens **84.—SEGREGATED ALUMINUM BORINGS AND TURNINGS**

Shall consist of clean, uncorroded aluminum borings and turnings of one specified alloy only and subject to deductions for fines in excess of 3% through a 20 mesh screen and dirt, free iron, oil, moisture and all other foreign materials. Material containing iron in excess of 10% and/or free magnesium or stainless steel or containing highly flammable cutting compounds will not constitute good delivery.

Telic **85.—MIXED ALUMINUM BORINGS AND TURNINGS**

Shall consist of clean, uncorroded aluminum borings and turnings of two or more alloys and subject to deductions for fines in excess of 3% through a 20 mesh screen and dirt, free iron, oil, moisture and all other foreign materials. Material containing iron in excess of 10% and/or free magnesium or stainless steel or containing highly flammable cutting compounds will not constitute good delivery. To avoid dispute should be sold on basis of definite maximum zinc, tin and magnesium content.

Tense **86.—MIXED ALUMINUM CASTINGS**

Shall consist of all clean aluminum castings which may contain auto and airplane castings but no ingots, and to be free of iron, dirt, brass, babbitt and any other foreign materials. Oil and grease not to total more than 2%.

Tepid **87.—WRECKED AIRPLANE SHEET ALUMINUM**

Should be sold on recovery basis or by special arrangements with purchaser.

Terse **88.—NEW ALUMINUM FOIL**

Shall consist of clean, new, pure, uncoated, unalloyed aluminum foil, free from anodized foil, radar foil and chaff, paper, plastics, or any other foreign materials. Hydraulically briquetted material by arrangement only.

Testy **89.—OLD ALUMINUM FOIL**

Shall consist of clean, old, pure, uncoated, unalloyed aluminum foil, free from anodized foil, radar foil and chaff, paper, plastics, or any other foreign materials. Hydraulically briquetted material by arrangement only.

Thigh **90.—ALUMINUM GRINDINGS**

Should be sold on recovery basis or by special arrangements with purchaser.

Thirl **91.—ALUMINUM DROSSES, SPATTERS, SPILLINGS, SKIMMINGS AND SWEEPINGS**

Should be sold on recovery basis or by special arrangements with purchaser.

Throb **92.—SWEATED ALUMINUM**

Shall consist of aluminum scrap which has been sweated or melted into a form or shape such as an ingot, pig or slab for convenience in shipping; to be free from corrosion, drosses or any foreign materials. Should be sold subject to sample or analysis.

Tooth **93.—SEGREGATED NEW ALUMINUM ALLOY CLIPPINGS AND SOLIDS**

Shall consist of new, clean, uncoated and unpainted aluminum scrap of one specified aluminum alloy only and to be free of foil, hair wire, wire screen, dirt, and other foreign substances. Oil and grease not to total more than 1%. Also free from punchings less than ½" in size. New can stock subject to arrangement between buyer and seller.

Tough **94.—MIXED NEW ALUMINUM ALLOY CLIPPINGS AND SOLIDS**

Shall consist of new, clean, uncoated and unpainted aluminum scrap of two or more alloys free of 70S series and to be free of foil, hair wire, wire screen, dirt, and other foreign substances. Oil and grease not to total more than 1%. Also free from punchings less than ½" in size. New Can Stock subject to arrangement between buyer and seller.

Tread **95.—SEGREGATED NEW ALUMINUM CASTINGS, FORGINGS AND EXTRUSIONS**

Shall consist of new, clean, uncoated aluminum castings, forgings, and extrusions of one specified alloy only and to be free from sawings, stainless steel, zinc, iron, dirt, oil, grease and other foreign substances.

CODE WORD ITEM

Trump 96.—ALUMINUM AUTO CASTINGS

Shall consist of all clean automobile aluminum castings of sufficient size to be readily identified and to be free from iron, dirt, brass, babbit bushings, brass bushings, and any other foreign materials. Oil and grease not to total more than 2%.

Twist 97.—ALUMINUM AIRPLANE CASTINGS

Shall consist of clean aluminum castings from airplanes and to be free from iron, dirt, brass, babbitt, bushings, brass bushings, and any other foreign materials. Oil and grease not to total more than 2%.

ITEMS NOT COVERED SPECIFICALLY IN ALUMINUM SCRAP SPECIFICATIONS SHOULD BE DISCUSSED AND SOLD BY SPECIAL ARRANGEMENTS BETWEEN BUYER AND SELLER.

Aroma 98.—NEW NICKEL SCRAP

Shall consist of clean new sheet, plate, bar, tube, and any other wrought nickel scrap solids. Nickel minimum 99%. Free of castings, as well as any foreign attachments or other contamination.

Burly 99.—OLD NICKEL SCRAP

Shall consist of old and/or new sheet, plate, bar, tube, and any other wrought nickel scrap solids. Material to contain a minimum of 93% nickel. This grade to be free of castings, soldered, brazed, sweated, or painted material, other metallic coating, foreign attachments, and any other contamination.

Cache 100.—MISCELLANEOUS TYPES OF NICKEL SCRAP

Shall consist of miscellaneous types of nickel scrap, such as carbonized scrap, castings, strippings, peelings, baskets, and/or turnings. Particulars regarding physical description, assay, and packaging to be agreed on between buyer and seller.

Dandy 101.—NEW CUPRO NICKEL CLIPS AND SOLIDS

Shall consist of clean, new, segregated (normally accepted analysis grades) either 70/30, 80/20, or 90/10 cupro nickel tube, pipe, sheet, plate, or other wrought solid forms. Must be free of foreign attachments or any other contamination.

Daunt 102.—CUPRO NICKEL SOLIDS

Shall consist of old, and/or new, segregated (normally accepted analysis grades) either 70/30, 80/20, or 90/10 cupro nickel tube, pipe, sheet, plate, or other wrought solid forms. Maximum 2% sediment allowable. Any other forms of cupro nickel solids such as castings, gates, risers, spills, etc., packaged separately, may or may not be included, only upon agreement between buyer and seller. Must be free of foreign attachments and all other contamination. Other particulars concerning physical description, analysis and packaging to be agreed upon between buyer and seller.

Delta 103.—SOLDERED CUPRO NICKEL SOLIDS

Shall consist of segregated (normally accepted analysis grades) either 70/30, 80/20, or 90/10 cupro nickel solids, soldered, brazed, or sweated, must be free of trimmed seams and edges and all other contamination.

Decoy 104.—CUPRO NICKEL SPINNINGS, TURNINGS, BORINGS

Shall consist of clean segregated (normally accepted analysis grades) either 70/30, 80/20, or 90/10 cupro nickel spinings, turnings, or borings. Particulars concerning physical description, analysis, packaging, to be agreed upon between buyer and seller.

Hitch 105.—NEW MONEL CLIPPINGS AND SOLIDS

Shall consist of clean, new, Regular and/or R-Monel sheet, plate, bar, rod, tube, pipe, or any other wrought scrap, free of any foreign attachments or any other contamination.

Ideal 106.—OLD MONEL SHEET AND SOLIDS

Shall consist of new and/or old clean Regular and/or R-Monel sheet, pipe, plate, rod, and all other wrought scrap solids. Must be free of foreign attachments or any other contamination. (To exclude soldered, brazed, and unclean sweated material.)

CODE WORD ITEM

Indian 107.—K-MONEL RODS AND OTHER SOLIDS

Shall consist of clean K-Monel rods and other solids.

Junto 108.—SOLDERED MONEL SHEET AND SOLIDS

Shall consist of soldered and/or brazed, Regular or Miscellaneous grades of Monel Alloys (with basic minimum 63% Nickel contained in any alloy itself), in either wrought or cast form. Must be free of trimmed seams and edges, nonmetallic filling, foreign attachments, and all other contamination. Particulars concerning physical description, assay, and packaging to be agreed upon between buyer and seller.

Lemon 109.—MONEL CASTINGS

Shall consist of various types of clean Monel castings, assaying minimum 60% nickel. Must be free of foreign attachments, or any other contamination.

Lemur 110.—MONEL TURNINGS

Shall consist of mixed Monel turnings and borings containing a minimum of 60% nickel content, on a dry basis.

Pekoe 111.—200 SERIES STAINLESS STEEL SCRAP SOLIDS

Shall consist of all types of clean AISI Series Stainless Steel Scrap Solids, which contain a maximum of .5% copper, free of foreign attachments and other contamination.

Sábot 112.—STAINLESS STEEL SCRAP

Shall consist of clean 18-8 type stainless steel clips and solids containing a minimum 7% nickel, 16% chrome, and have a maximum of .50% molybdenum, .5% copper, .045% phosphorous, and .03% sulfur, and otherwise free of harmful contaminants. Particulars concerning physical description, grading, additional analysis, and preparation to be agreed upon between buyer and seller.

Ultra 113.—STAINLESS STEEL TURNINGS

Shall consist of clean 18-8 type stainless steel turnings containing a minimum of 7% nickel and 16% chrome, and to be free of nonferrous metals, non-metallics, excessive iron, oil and other contaminants. Particulars concerning physical description, assay, packaging to be agreed upon between buyer and seller.

Rusten 114.—11-14% CHROME STAINLESS SCRAP

Straight chrome stainless scrap shall contain 11-14% chrome, phosphorous and sulphur .03% maximum, and shall not contain over .50% nickel and otherwise be free from harmful contaminants. Material to be prepared to individual consumer's specifications.

Rusthirty 115.—14-18% CHROME STAINLESS SCRAP

Straight chrome stainless scrap shall contain 14-18% chrome, phosphorous and sulphur .03% maximum, and shall not contain over .50% nickel and otherwise be free from harmful contaminants. Material to be prepared to individual consumer's specifications.

Vaunt 116.—EDISON BATTERIES

To be sold free of crates, copper terminal connectors, and drained free of excess liquid, to be free of type "B" batteries.

ANY OTHER PARTICULARS IN THE NICKEL ALLOY GROUP CONCERNING PHYSICAL DESCRIPTION, ASSAY, AND PACKAGING TO BE AGREED UPON BETWEEN BUYER AND SELLER.

GENERAL NOTE

It has been the purpose in revising these specifications to provide for those materials which are most frequently dealt in. Any items for which classifications are not specified should be subject to negotiations between buyer and seller.

IDENTIFICATION CHECK LIST FOR PRECIOUS METALS

Because in the precious metals industry values are derived from the *exact* analysis obtained from a representative sample, it is not possible to develop a set of specifications similar to those NASMI has established for other nonferrous metals.

This Identification Check List, however, for the first time sets up a general basis for identifying types and grades of precious metal scrap by the scrap processor which will be familiar both to the precious metal refiner and to the plants generating precious metal scrap.

By checking this identification list, the scrap processor gives the refiner a fairly accurate conception of the material he has on hand and offers a basis for the refiner to quote an estimated price for the material.

Though this Identification Check List is added to NASMI's specification circular, it is to be cautioned that these are not specifications but are to be regarded as a guideline for scrap processors and refiners.

Due to the high value and the constantly changing character of precious metal scrap it is the practice in the industry to require a sample to be submitted before giving refining schedules.

I. SCRAP SOURCES

REFINED SILVER METAL—99.9 PLUS PERCENT

SILVER BEARING MATERIALS:

- Anodes
- Assemblies—Electrical
- Batteries
  - Silver/Copper
  - Silver/Cadmium
  - Silver/Zinc
  - Silver/Magnesium
- Blanking Scrap—Punchings
- Brazing Alloys
- Brushes—Electric Motors
- Bullion
- Chemical Salts
- Clad Bi-Metal Parts
- Coin Silver
- Contacts
- Dental Amalgam
- Film
  - Industrial X-Ray
  - Medical X-Ray
  - Lithographic
  - Photographic Negatives
- Filters—Plating
- Flake—From Hypo Solution Recovery Systems
- Hooks—Plating—Nodules
- Jewelry Sweeps
- Paints—Paste
- Paper—Reproduction
- Plated Parts—Electrical—Electronic
- Plated Serving Pieces
- Plated Utensils
- Plated Wire
- Powders—Granulated
- Punchouts
- Relays—Electrical
- Resins
- Silver Lined Bearings—Diesel Locomotives and Aircraft
- Sludges—Plating and Precipitates
- Solutions—Plating
- Sterling Silver
- Tin Lead Alloys—Contaminated
- Turnings
- Wave Guides
- Wiping Rags

REFINED GOLD METAL—99.9 PLUS PERCENT
REFINED GOLD SPONGE—99.9 PLUS PERCENT

GOLD BEARING MATERIALS:

- Brazing Alloys
- Cladmetal Parts
- Contacts
- Dental Alloys
- Dental Scrap
- Dental Sweeps and Grindings
- Diodes
- Filled Scrap
- Filters—Plating
- Flakes
- Flashings
- Foil
- Hooks—Plating—Nodules
- Jewelry Scrap
- Jewelry Sweeps and Grindings
- Paints and Paste
- Peelings
- Placer Gold
- Plated Parts—Electrical
- Plated Wire
- Powders
- Printed Circuit Boards
- Printed Circuit Boards with Components
- Punchouts
- Resins—Plating
- Salts—Chemical
- Sludges—Plating
- Solutions
- Sponge
- Tin Lead Alloys—Contaminated
- Transistors
- Wiping Rags
- Wire

REFINED PLATINUM METAL—99.9 PLUS PERCENT
REFINED PLATINUM SPONGE—99.8 PLUS PERCENT

PLATINUM BEARING MATERIALS:

- Catalysts
- Chemicals
- Clad Materials
- Contacts
- Dental Alloys
- Dental Scrap
- Dental Sweeps, Grindings
- Jewelry Scrap
- Jewelry Sweeps
- Laboratory Ware
- Magneto Points
- Powders and Paste
- Solutions—Plating
- Spark Plugs—Aircraft
- Thermocouple Wire

REFINED PALLADIUM METAL—99.8 PLUS PERCENT
REFINED PALLADIUM SPONGE—99.8 PLUS PERCENT

PALLADIUM BEARING MATERIALS:

- Catalysts
- Clad Materials
- Contact Points
- Dental Alloys
- Dental Scraps
- Dental Sweeps
- Jewelry Scrap (Sweeps)
- Paste
- Plated Parts
- Powders
- Relays—Electrical
- Salts—Chemical
- Sludges
- Solutions
- Wire

SCRAP CONTAINING COMBINATIONS OF PRECIOUS METALS (GOLD, SILVER, PLATINUM AND PALLADIUM)

- Assemblies—Components
- Bullion
- Carbon
- Catalysts
- Chemicals
- Chips
- Drillings
- Electronic Scrap
- High Temperature Resistant Alloys
- Paste
- Powders
- Paints
- Relays—Electrical
- Resins
- Ribbons
- Rings
- Salts
- Solutions
- Sweeps
- Telephone Switching Scrap
- Thick Film
- Wire

II. SCRAP CATEGORIES

A. Solution
  1. Acid
  2. Basic
  3. Matrix if known

B. Resin

C. Sludges

D. Burnable Material
  1. Carbon
  2. Filters
  3. Film
  4. Papers
  5. Unprepared Sweeps
  6. Others

E. Sweeps (Prepared)

F. Printed Circuit Boards
  1. Punch Outs
  2. Non Assembled
  3. Assembled
  4. Other . . . . . .

G. Glass to metal Tubes, etc.
  1. Solid Precious Metal Parts
  2. Alloyed Metal Parts
  3. Plated Metal Parts
  4. Ceramics
  5. Thick Film
  6. Other . . . . . .

H. Metal Scrap

I. Non Magnetic
  1. Impure Gold
  2. Impure Silver
  3. Copper Base
  4. Aluminum Base
  5. Brass Base
  6. Bronze Base
  7. Molybdenum Base
  8. Beryllium Base
  9. Lead Base
  10. Tin Base
  11. Other . . . . . .

II. Magnetic
  1. Kovar Base
  2. Stainless Steel Base
  3. Iron Base
  4. Nickel Base
  5. Other . . . . . .

I. Catalyst
  1. Carbon
  2. Alumina
  3. Rare Earth
  4. Silica
  5. Other . . . . . .

(Continued on next page)

IDENTIFICATION CHECK LIST FOR PRECIOUS METALS

(Continued)

III. CONDITION

A. Alloy
B. Mixture
C. Exposed
D. Fused
E. Soldered
F. Welded
G. Hidden
H. Inside
I. Surface
J. Clad
K. Filled
L. Plated
M. Casting
N. Other . . . . . .

IV. VOLUME

Weight .... lbs.

Volume .... gallons

V. PRECIOUS METALS CONTENT

	Gold	Silver	Platinum	Palladium	Rhodium	Ruthenium	Iridium	Base/Matrix
Precious Metal Est. % Content								
Trace 0.5%								
0.51 to 2.0%								
2.01 to 10.0								
10.01 to 20.0								
20.01 to 30.0								
30.01 to 40.0								
40.01 to 50.0								
50.01 to 60.0								
60.01 to 70.0								
70.01 to 80.0								
80.01 to 90.0								
90.01 to 95.0								
95.01 to 100.0								

January 26, 1976
1967 Yale Avenue
Butte, Montana

Mr. Barry E. Damschen
Project Engineer
Henningson, Durham & Richardson
2225 Eleventh Avenue
Helena, Montana

Dear Sir:

In answer to your letter of January 6, 1976, I am still very much interested in the opportunity to bid on ferrous metals.

It is impossible to put a price on any of this material because as you know it flucuates with the world markets. However, as to the tin cans the Anaconda Company sets the price on the local market.

When the City of Great Falls asked for bids, my bid second high which was because of long term contracts with Vulcan Materials Corporation. However, on any kind of a guaranteed supply, I am assured that we could have the order for whatever we could supply.

The iron, aluminum, copper or whatever would be payed for at what ever the U. S. market happened to be at any given time.

I have in the past delivered over a million pounds of cans to the local supplier who is no longer here. They were from Spokane, Washington, Great Falls, Bozeman, Helena, Butte and small towns in the surrounding area.

Trusting this is the information you want.

Respectfully,

Carl W. Hafer Sr.

Carl W. Hafer, Sr.
1967 Yale Avenue
Butte, Montana, 59701

TEXT OF LETTER SENT TO POTENTIAL GLASS MARKETS

Dear Sir:

Our firm has been retained by the State of Montana, Department of Environmental Sciences to conduct a solid waste management and resource recovery study for all solid wastes generated in the state. Included in the scope of work is the analysis of potential markets for secondary materials which may be recovered from the state's wastes.

A solid waste generation and composition study completed last fall indicated that approximately 4.3 percent of the total waste generated in the state is composed of glass. Based on this data it is estimated that approximately 28,000 tons of glass will be disposed of in 1980.

At the present time it is not possible to predict what percentage of the wastes generated in Montana can be processed and recovered economically. This information will be determined later in the study after processing and transportation costs and potential revenues of recoverable materials have been determined. It is, however, very unlikely that the results of the study will indicate that it is feasible to process in excess of 50 percent of the wastes generated in the state at the present time.

It would be most helpful to learn if your company would be interested in purchasing the separated glass when and if it becomes available, and a general indication of its market value. Since the refuse processing system(s) has not been defined, we would appreciate receiving any guidance on specifications or requirements you can provide.

Due to the time schedule of the study, we would appreciate very much receiving as soon as possible a letter indicating your interest. If you have any questions, please feel free to call us at your earliest convenience.

Very truly yours,

HENNINGSON, DURHAM & RICHARDSON, INC. of MONTANA

Barry E. Damschen
Project Engineer

BED:cjk

OWENS-ILLINOIS
Glass Container
Division

Engineering & Research
Department
Technical Center

January 28, 1976

Mr. Barry E. Damschen
HENNINGSON, DURHAM & RICHARDSON
2225 Eleventh Avenue
Helena, MT 59601

Dear Mr. Damschen:

Thank you very much for your recent letter regarding our interest in utilizing, in our glass container plants, glass recovered from municipal solid waste. Owens-Illinois would be interested in utilizing a cullet which meets our specification in their glass furnaces. Generally, the material has a value comparable to batches which go into glass container manufacture. This is in the $20 to $30 per ton delivered range.

I am enclosing our cullet specifications, as well as brochures indicating the locations of Owens-Illinois glass container plants and other glass container manufacturers located throughout the United States. Also, I am enclosing a brochure on the use of glass in secondary products.

If we can be of further help, please feel free to call.

Sincerely,

John Minns

JOHN MINNS
Solid Waste Utilization

bds
Enclosures

Post Office Box 1035 Toledo, Ohio 43666 (419) 242-6543

GCMI SPECIFICATIONS
FOR
GLASS FROM RESOURCE RECOVERY SYSTEMS
9/25/75

THE CULLET OF THIS QUALITY WOULD BE USABLE AS FULL SUBSTITUTION FOR IN-HOUSE CULLET IN MOST CASES. EACH MEMBER COMPANY, HOWEVER, MAY RESERVE THE RIGHT TO ACCEPT OR REJECT THIS SPECIFICATION FOR ITS OWN USE.

1. A representative sample must meet the following specifications to qualify the glass lot to be used for direct use in soda lime glass container manufacturing (see supplement #1). Sample should be prepared and examined per GCMI Glass Quality Test Methods and Procedures.

2. Specifications: The sample must not contain more than the percentage fraction of each of the following contaminants based upon dry weight:

2.1. Liquid--------------No drainage from sample, non-caking and free-flowing (see note in supplement).

2.2. Screen Size---------0% retained on 2" mesh screen.

15% maximum to pass through a U. S. series 140 mesh screen.

2.3. Organic Substances--Total organics as measured per GCMI Test Methods shall not exceed 0.2% of dry sample weight.

2.4. Magnetic Materials--0.05% of dry sample weight; no particle size shall exceed 1/4".

2.5. Allowable Color Mix for Color-Sorted Glass

2.5.1.	Flint Glass*	-	90-100%	Flint
			0-5%	Amber
			0-1%	Green**
2.5.2.	Amber Glass	-	90-100%	Amber
			0-10%	Flint
			0-10%	Green
2.5.3.	Green Glass	-	50-100%	Green
			0-35%	Amber
			0-15%	Flint

*Flint glass containing over 0.1% Fe_2O_3 and/or 0.002% Cr_2O_3, as determined by chemical analysis, shall be considered mixed color glass.

**Flint glass can contain up to 1% emerald green or 10% Georgia green, or a combination within these limits. Note: (1% of Georgia green equals 0.1% emerald green.)

2.6. Inorganic Material (non-magnetic metal, refractories, and other solid inorganics) - Total inorganics 0.1% of dry sample. No particle shall exceed 1/4". (See GCMI Test Method, Section 2.6.)

2.6.1. Refractories - Based upon U. S. series screen size and sample weight, the following refractory particle count will apply.

+20 mesh	1 particle per 40# sample. No particle shall exceed 1/4".
-20+40 mesh	2 particles per 1# sample.
-40+60 mesh	20 particles per 1# sample.

2.6.2. Non-magnetic metals

+20 mesh	1 particle per 40# sample. No particle shall exceed 1/4".

Supplement #1 Soda-Lime Glass - A preponderant proportion of glass cullet will be soda-lime bottle glass. The glass will have a limited composition range approximately as follows:

SiO_2	69.0 to 75.0%
R_2O_3 (Al_2O_3)	1.0 to 4.0%
CaO + MgO	9.0 to 13.0%
Na_2O	12.0 to 16.0%

Supplement to 2.1. Liquid

"Non-caking and free-flowing." A moisture content of less than 0.5% by weight would probably be necessary to meet the free-flowing characteristic of a cullet which is predominately of small particle size (-16 U. S. series mesh).

GCMI TEST METHODS
FOR
COLOR-SORTED AND NON-COLOR-SORTED
SODA LIME GLASS

9/25/75

1.0. Sample

The test sample must be representative of the lot.

2.0 Select an 80# sample and split into a 40# sample and a 5# sample lot. The same 5# sample may be used in test sections 2.1 through 2.5. The 40# sample is to be used in Section 2.6.

2.0. Glass specifications sections to be tested by the following methods:

2.1. Liquid

2.1.1. Drainage: No visible liquid drainage.

2.1.2. The 5# sample to be dried at 110° C for 2 hours.

$$\% \text{ Moisture} = 100 - \left[\frac{\text{Dry Wt.}}{\text{Original Wt.}} \times 100\right]$$

2.2. Screen Size (same as specification 2.2)

2.3. Total organics (plastic, paper and other combustibles). Use uncovered porcelain crucible(s). Heat sample to 1000° F (538° C) for 1/2 hour or until all smoke or flame has ceased.

$$\text{Calculate } \% \text{ L.O.I.} = 100 - \left[\frac{\text{Wt. after ignition}}{\text{Dry Wt.}} \times 100\right]$$

2.4. Magnetic Material

2.4.1. Remove magnetic material with magnet. (Permanent Alnico or equiv.)

2.4.2. Weigh magnetic material collected.

2.4.3. Calculate % magnetic metal as follows:

$$\% \text{ magnetic metal} = \left[\frac{\text{Wt. magnetic metal}}{\text{Dry Wt.}} \times 100\right]$$

2.4.4. Determine number of particles exceeding 1/4".

2.5. Off-color Glass

Pick out off-color glass particles from sample on an inspection table under 5x magnification and 200 foot-candle illumination. Weigh off-color fractions and grade according to color mix table in specification section 2.5.

2.6. Total inorganic material (non-magnetic metal, refractories and other solid inorganics)

2.6.1. Sample size: 40#

2.6.2. Examination of glass for inorganic particles.

The fusion test is an empirical one with the primary purpose of eliminating materials of no concern from a refractoriness standpoint to facilitate inspection of the remaining materials. The materials remaining in the fusion residue are not necessarily refractory in glass furnaces and must be evaluated individually. (See note no. 1.)

2.6.2.(a) For glass containing large amounts of +20 mesh material, screen the sample of 40# through a 1/4" mesh screen. If the glass is not dry, the +1/4" mesh material must be washed on the screen. Pick out non-glass particles from material remaining on screen and determine if any are metallic or inorganic. Discard +1/4" mesh glass. Save -1/4" mesh fraction and dry if necessary.

2.6.2.(b) Screen the dry -1/4" mesh fraction through 20 mesh U.S. series screen. Pick out non-glass particles from material remaining on screen by using 5x magnification and 200 foot-candle illumination. Determine how many are non-magnetic metal. Discard magnetics. Fuse remaining +20 mesh non-glass particles per procedure 2.6.2.(g) through (i). Screen fusion product through 20 mesh screen. Count number of particles on this screen which remain hard and appear unaltered except for possible reduction in size. Exclude particles rendered soft and friable by the fusion procedure. The hard particles will be considered refractory until the glass container manufacturer can certify otherwise. Relate particle count remaining on screen to specification section 2.6.1.

2.6.2.(c) If -20 mesh fraction constitutes more than one pound of material, take representative one-pound aliquot for heavy liquid separation. Otherwise, use entire -20 mesh fraction.

2.6.2.(d) Construct a separatory apparatus by using equipment such as: a 600 ml filter funnel (6" at top with 1/2 O.D. stem). Attach a 4" long Tygon tube with suitable hose clamp. Partially fill funnel with liquid which has a specific gravity of 2.65. (See note no. 2.)

2.6.2.(e) Pour sample into separatory apparatus. Add 2.65 sp. gr. liquid until nearly full. Stir 10 times with sufficient intervals between stirrings to allow bulk of sample to rise to top of liquid.

2.6.2.(f) Carefully unclamp end of tubing to flush heavy particles into beaker. Decant liquid from beaker back into funnel. Wash heavy particles with alcohol. Rinse with acetone or ether to dry.

2.6.2.(g) Remove magnetic materials from heavy particles and discard. Weigh remaining heavy particles. Transfer to crucible. Weigh out seven times as much sodium carbonate as weight of heavy particles. Add sodium carbonate to crucible and mix. Either a platinum or porcelain crucible can be used. If metallic contaminants are present, use porcelain.

2.6.2.(h) Fuse mixture for 10 minutes at maximum heat obtainable from a Meker-type laboratory burner.

2.6.2.(i) Neutralize fusion residue with 3N HCl. Decant and discard spent liquid. Wash residue with water. If sufficient silica gel has formed to obstruct vision, add concentrated KOH and warm. Decant, wash with water, rinse with acetone and dry.

2.6.2.(j) Screen through 40 and 60 mesh U. S. series screen.

2.6.2.(k) Count number of particles on each screen which remain hard and appear unaltered except for possible reduction in size. Exclude particles rendered soft and friable by the fusion procedure. The hard particles will be considered refractory until the glass container manufacturer can certify otherwise.

2.6.2.(l) Relate these particle counts to specification section 2.6.1.

NOTES:

1. These materials are known to be refractory in glass in sizes of 60 mesh or larger: corundum, mullite, zircon, chromite, spinel, sillimanite, andalusite, kyanite, cassiterite.
2. Heavy liquids are commonly a mixture of s-tetrabromoethane and bromonaphthalene. Isopropyl salicylate or monochlorobenzene may be used in place of bromonaphthalene. 2.65 sp. gr. Sink-Float density standards for readily checking and adjusting liquid densities can be purchased from most laboratory supply houses.

TEXT OF LETTER SENT TO POTENTIAL PAPER MARKETS

Dear Sir:

Our firm has been retained by the State of Montana, Department of Environmental Sciences to conduct a solid waste management and resource recovery study for all solid wastes generated in the state. Included in the scope of work is the analysis of potential markets for secondary materials which may be recovered from the state's wastes.

A solid waste generation and composition study completed last fall indicated that approximately 25 percent of the total waste generated in the state is mixed paper and 10 percent is corrugated. Based on this composition data, it is estimated that approximately 115,000 tons per year of mixed paper and 46,000 tons per year of corrugated will be disposed of in the state in 1975.

Since you are a major buyer of secondary fibers when market conditions are favorable, we would appreciate as assessment of your interest regarding the purchase of the mixed paper and corrugated found in the State of Montana solid waste stream. We feel the secondary fibers which could be marketed would be recovered by hand sorting and careful route selection. Based on your years of operating in the state and around the country, we would value your opinion concerning amounts of corrugated and mixed paper the state could conceivably recover effectively. It is conceivable that we may find it not feasible for any city in the state to sort for corrugated or mixed paper but perhaps such an operation could be accomplished by companies like yourself who are set up to handle the process.

We do not wish to secure a price quotation from you at this time, since you conceivably might have to bid on the product at some future date and it would not be fair to make your figures public. However, it would be helpful if you could suggest a range of values based on past experience for the area, or reference some common index or commodity rate percentage so that we can suggest maximum ranges of anticipated revenues. A copy of your material procurement specifications would be helpful, and any special requirements such as baling, F. O. B. point, etc., should be stipulated.

Due to the time schedule of the study, we would appreciate very much receiving as soon as possible a letter indicating your interest. If you have any questions, please feel free to call us at your earliest convenience.

Very truly yours,

HENNINGSON, DURHAM & RICHARDSON, INC. of MONTANA

Barry E. Damschen
Project Engineer

BED:cjk

AREA CODE: 312
TELEPHONE: 346-4800
TELEX: 25-3020

PAPER STOCK INSTITUTE of America

NATIONAL FIBER SUPPLY CO.

PAPER MILL SUPPLIES

55 EAST MONROE STREET
CHICAGO, ILLINOIS 60603

January 27, 1976

Mr. B. E. Damschen
Henningson, Durham & Richardson, Inc.
of Montana
2225 Eleventh Avenue
Helena, Montana 59601

Dear Mr. Damschen:

Thank you very much for your letter of January 12 inquiring about markets and outlets for Solid Waste generated in the State of Montana.

It is our experience, having been in business since 1911, that these grades cannot move on a regular basis except on nominal freights. This means that, without a consuming mill in the State of Montana, there is no chance for regular, long term movement.

Thus, it would be only in times of extreme shortage that mills in this area could afford to justify paying such long freights.

For your information, the current Chicago market for Mixed Paper is $10 to $12 f.o.b. shipping point, and for Corrugated is $20 f.o.b. shipping point. The freight rates from Montana to the Chicago area far exceed the value of the merchandise.

Although this information provides no incentive for a project such as you envision, we feel that it is our responsibility to frankly describe the economic exigencies that govern the accumulation and sale of such grades of waste paper.

Very truly yours,

NATIONAL FIBER SUPPLY CO.

Philip A. Alpert

P. A. Alpert

PAA:if

NATIONAL ASSOCIATION OF RECYCLING INDUSTRIES
MEMBER
ORGANIZED 1913

UNITED PAPER STOCK COMPANY
PAPER FIBRES

33 INDIA STREET
PAWTUCKET, R. I. 02860

TELEPHONE
AREA CODE (401)
724-5700

CORRUGATED BOXES
PAPER PRODUCTS

February 17, 1976

Henningson, Durham & Richardson
2225 Eleventh Avenue
Helena, Montana 59601

Gentlemen:

We are sorry for the delay in answering your letter of January 13th which was mislaid.

We must report that due to the distance and market conditions involved we would not be interested, at this time, in participating in the purchasing of the waste paper from the State of Montana.

We appreciate your interest in us. Please feel free to call upon us again if you believe that we can be of some assistance to you.

Very truly yours,

UNITED PAPER STOCK COMPANY

Harold L. Cohen

Harold L. Cohen

HLC:jml

TECHNICAL ASSISTANCE AND BUSINESS SERVICES TELEX 944479

Gorham International Inc.

ESTABLISHED 1956

GORHAM, MAINE 04038, U.S.A. · TELEPHONE: 207/892-6761 · CABLE ADDRESS: GORHAM · PORTLAND, MAINE

February 23, 1976

Mr. Barry E. Damschen
Henningson, Durham & Richardson
2225 Eleventh Avenue
Helena, MT 59601

Dear Mr. Damschen:

Thank you for your February 11, 1976 letter inquiring about Gorham's recent study on solid waste energy recovery for the pulp and paper industry.

This report resulted from a multi-client study supported by interested companies. The study report is available under a subscription agreement similar to those executed with the original subscribers. The enclosed announcement presents the table of contents and subscription details. Also enclosed is an announcement describing an earlier study dealing strictly with the municipal solid waste energy recovery situation.

In addition to the above studies, Gorham performs a variety of energy and solid waste related projects. The enclosed energy technology brochure describes our energy related capabilities in greater detail.

We thank you for your interest in our activities and look forward to hearing further from you so that we may discuss mutual interest areas.

Very truly yours,

GORHAM INTERNATIONAL INC.

Alvin G. Keene, P.E.
Director of Process and
Environmental Management

AGK/j
Enclosures

GSP
GARDEN STATE PAPER COMPANY, INC.
PARK 80 PLAZA EAST, SADDLE BROOK, NEW JERSEY 07662 / TELEPHONE: (201) 843-1450

January 30, 1976

Mr. Barry E. Damschen
Project Engineer
Hennington, Durham & Richardson, Inc.
2225 Eleventh Avenue
Helena, Montana 59601

Dear Mr. Damschen:

Thank you for your letter to Bruno & D'Elia regarding possible interest in the purchase of mixed paper and corrugated that is expected to be generated from the State of Montana's resource recovery program.

Let me explain first that Garden State Paper Company is the parent organization of Bruno & D'Elia. We are the world's largest recycler of used news into fresh newsprint.

With recycling mills in Garfield, N.J., Pomona, Calif., and Alsip, Ill., we are always interested in learning of new sources of waste news. However, as you can appreciate, transportation costs from Montana to any of our mills could be a serious problem.

To comment further on your letter, the extent of mixed paper that you might recover from the waste stream could range from 10 to 40 percent. We know of communities above the 40 percent level. However, reaching a high percentage rate depends upon educating the community and getting its enthusiastic support. Also, community size and density are major factors in a successful program. Therefore, do not allow your estimation of collection percentage to hinge solely on an extrapolation of state consumption.

With regard to a range of values, we have enclosed a recent copy of Fiber Market News. This indicates general current pricing for different grades of paper.

You also might find it helpful in terms of further study to write to the National Center for Resource Recovery in Washington,

D.C. It's located at 1211 Connecticut Avenue, N.W. The zip is 20036. The Center and its director, Dr. Rocco Petrone, would be interested in any new statewide solid waste management and resource recovery programs and, no doubt, could provide you with invaluable advise in determining the feasibility of a program.

In addition, you might find the booklet "Residential Paper Recovery, A Municipal Implementation Guide" of value. A copy can be secured by writing to Penelope Hansen at the Environmental Protection Agency in Washington. The address is 401 M Street, S.W. The zip is 20460. This booklet contains sample specification contracts, ordinances and other helpful information.

We hope this background can be of assistance and we would appreciate learning of your progress.

Sincerely,

John P. Lynch
Vice President
Administration

JPL:le
enclosure